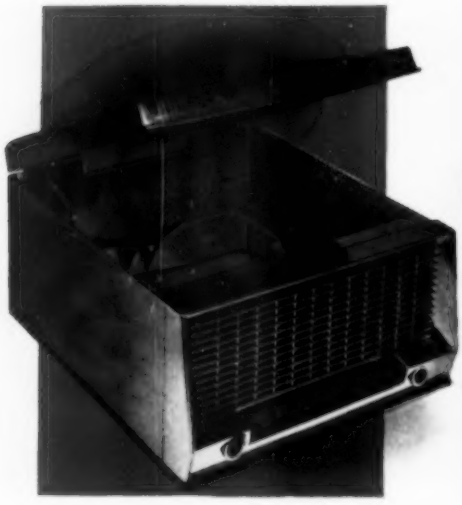
JOURNAL

VOLUME 8 NUMBER 4 • APRIL 1952

UNIV. OF MICHIGAN
MAY 9 1952
EAST ENGINEERING
LIBRARY

World's largest thermoplastic molding is shown above coming off the press at Amos Molded Plastics, Edinburg, Ind. This product, weighing seven and a half pounds and with an area of 1240 square inches, is a complete refrigerator door-liner with molded-in shelves, butter compartment, egg racks, manufactured for the Admiral Corporation. Production of the new giant molding, marking a milestone in plastics industry, was announced at opening of the National Plastics Exposition in Philadelphia by Dale Amos, general manager of Amos Molded Plastics.

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.



Beauty of mahogany mottle finish, fine details, scratch-resistance, light weight and strength at reasonable cost feature this cabinet for Philco radio-phono combination. It's **BAKELITE BM-780 General-Purpose Phenolic.**

Molded by The General Industries Co., Elyria, Ohio, and American Insulator Corp., New Freedom, Pa.

Strength and stability! This impeller for Sears, Roebuck's Kenmore Dishwasher is made of **BAKELITE Water-Resistant, Improved-Impact Phenolic BM-13080.** It stands up under whirling, scalding water, blasts of hot air, attack by soap and detergents.

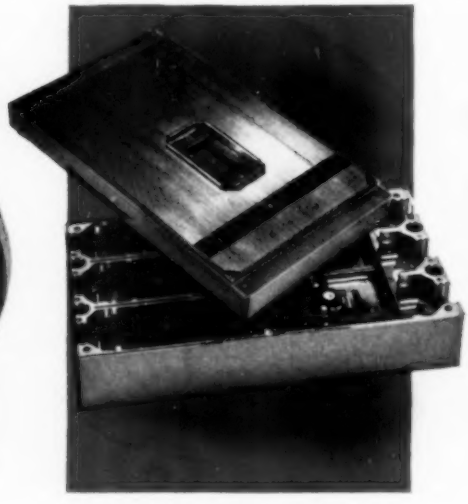
Molded by Martindell Molding Co., Trenton, N. J.

Service for six years without failure on New York's subways—despite weather extremes, moisture, vibration 20 hours a day! It's a subway shoe contact fuse housing that has been molded from **BAKELITE Medium Impact-Resistant Phenolic BM-1132.**

Made for The Horne Products Co. by Boonton Molding Co., Boonton, N. J.

High resistivity, low-loss factor, and dimensional stability are all built into these bases for diheptal tubes in television sets. They're **BAKELITE Natural "Low-Loss" Insulation Phenolic BM-16981.**

Made for Sylvania Electric Products Inc. New York, N.Y.



Intricate design and electrical resistivity—up to 600 volts AC, 250 volts DC, 10-600 amps.—are two of many features of this I-T-E Circuit Breaker case molded of black **BAKELITE General-Purpose Phenolic BM-2498.**

Made for I-T-E Circuit Breaker Co., Philadelphia, Pa., by American Insulator Corp., New Freedom, Pa.

Heat resistance, good electrical properties combine in this magneto distributor plate for heavy-duty automotive equipment. It's **BAKELITE BM-18425 General-Purpose Phenolic** with improved electrical insulation qualities.

Made for American Bosch Corp. by Specialty Insulation Mfg. Co., Hoosick Falls, New York.

Why Phenolic Plastics get the job!

The wide variety of BAKELITE Phenolic Plastics means that you can pick the *right* combination of properties to suit your particular purpose.

And with *all* BAKELITE Phenolic Plastics, you'll get the plus-factors of strength, beauty, economy, ease of production. Their resistance to chemicals and moisture, good electrical properties, long service life, and light weight are added features you can't afford to overlook.

Select the phenolic molding material that's best for your application...put it to work for your product. It means improved design, better performance, more saleability! Our Engineers will be glad to help you. Write Dept. DW-43

BAKELITE
TRADE-MARK
PHENOLIC PLASTICS

TRADE (B) MARK

BAKELITE COMPANY
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
In Canada:
Bakelite Company (Canada) Ltd., Belleville, Ont.

JOURNAL

Vol 8 April 1952 No. 4

Published monthly except July and August by the

SOCIETY OF PLASTICS ENGINEERS, INC.
409 SECURITY BANK BLDG.
ATHENS, OHIO

Dr. Jesse H. Day, Editor

Editorial Advisory Board: MARIO PETRETTI, J. H. DU BOIS, WAYNE PRIBBLE, CARL J. FROSCH

30 cents a copy **$3.00 a year**

Entered as second-class matter at the Post Office at Athens, Ohio.

Copyright 1952 by the Society of Plastics Engineers, Inc.

INDEX

ARTICLES

Molding of Heavy Sections—Gordon Thayer 5

Modified Phenolics—Wyman Goss 13

New Applications and Design of Plastics 16

Stress Gremlins in Thermosetting Plastics—H. M. Quackenbos 19

Successful Designing for Plastics Molding—W. M. Halliday 23

FEATURES

Book Review 3

The Injection Molderscope—by A. R. Morse 12

SECTION NEWS

Buffalo, 11, 25; Chicago, 25; Cleveland, 25; Connecticut, 26; Detroit, 27; Fort Wayne, 26; Miami Valley, 24; New York, 26; Northwest Pennsylvania, 18; Philadelphia, 25; Rochester, 24; Southeastern Ohio, 24; Toledo, 27; Western New England, 22.

ADVERTISERS

Bakelite Co., a division of Union Carbide and Carbon Corp. 2

Barrier-Pribble and Co. 21

Injection Molders Supply Co. 11

Kinco Products, Inc. 28

Metasap Chemical Co. 27

Watson-Stillman 4

The Society of Plastics Engineers Journal is not responsible for the views expressed by individual contributors. Copy for each issue should be received at 409 Security Bank Bldg., Athens, Ohio, before the fifth of each month.

Letters to the Editor

Kind Words

You are to be greatly complimented on the March 1952 issue of the Society's magazine. Our Dr. W. P. Moeller of the laboratory has found it so interesting that he requested six additional copies.

Yours very truly,
R. H. Skidmore
Celanese Corp. of America
180 Madison Ave.
New York 16, N. Y.

Dr. D'Alelio was very much pleased with the tear sheets from the March SPE Journal which you sent him and has turned your letter over to me for answering.

We would like to order two-hundred reprints of the article to be sent to my office. The bill for same also may be sent to me.

Thank you very much for the nice handling you gave this article.

Sincerely yours,
George Van Gundy,
Manager of Press Relations

I just received the March issue of the S.P.E. Journal and I think it is really terrific. It tops anything that has ever been put out.

Yours sincerely,
Dan E. Otto, Chairman
Society of Plastics Engineers
St. Louis Chapter.

Ed's note: Thanks for the kind words. We're always trying to make the SPE Journal do its job well. Look for the new feature, starting in September, which will bring you the best of the foreign articles.

Book Review

Vinyl and Related Polymers by C. E. Schildknecht, published by John Wiley and Sons, 440 Fourth Ave., New York City. 723 pages. Price $12.50.

This book is another significant milestone in the coming of age of the plastics literature. To the best of the reviewer's knowledge, this is the first book to treat the vinyl polymers and copolymers exhaustively.

The plan of the book is as follows: for each vinyl polymer, as for example styrene, there is a brief historical introduction, then a discussion of the manufacture and properties of the monomer, followed by a detailed description of methods and conditions of polymerization, with excellent treatment of the physical properties of the polymer and its applications. This plan is carried out for a surprisingly complete list of polymers.

While the book is primarily for the chemist (and it would be an excellent text for a one semester course in vinyl polymers) it should be of interest to those in the plastics industry whose position demands an extensive knowledge and understanding of the properties of plastics, and who are responsible for selecting the proper materials for new applications.

The author and publishers are to be complimented for this authoritative and easily readable book.

W-S PREPLASTICIZERS

mold more...FASTER

with present equipment.

Yes, the fastest way to increase the productive capacity of your plant, is to install on your present injection molding machines—Watson-Stillman PREPLASTICIZERS.

Years away from the experimental stage, W-S modern PREPLASTICIZING Units are designed and built to mount right into position on present machines, and when installed, they give you the following advantages in your molding operations:

1. **Shorter Molding Cycles . . . In many cases cycles can be cut one-third to one-half.**
2. **Piece weight savings in a great number of cases can be immediately realized.**
3. **Better Moldings . . . Because the material in the shooting cylinder is completely plasticized at the start of the injection stroke, injection pressures in most cases can be reduced fifty percent or more, resulting in strain-free moldings and less rejections.**
4. **Thinner Sections possible . . . Wherever warranted, thinner sections are obtainable by means of using maximum injection pressure on the plasticized material without the pressure restriction caused by the torpedo.**

And . . . don't forget, WATSON-STILLMAN has been building PREPLASTICIZERS for years and offers a complete line of these units for all E—Series injection molding machines. Let us tell you more about them. Write today.

9-AA-3"S

W-S "COMPLETELINE"—SHORTEST DISTANCE FROM PRODUCTION TO PROFIT

HYDRAULIC MACHINERY DIVISION

WATSON-STILLMAN

W-S HYDRAULIC

Established 1848

Main Office, 153 Aldene Rd., Roselle, New Jersey

Branch Office: 228 No. La Salle St., Chicago, Ill.

Manufactured in Canada by—Canadian Vickers, Ltd., Montreal

Foreign Sales Representatives: OMNI PRODUCTS CORP.

460 Fourth Avenue, New York 16, N. Y.

DuBois Is Mycalex Vice-President

Mr. Jerome Taishoff, President of the Mycalex Corporation of America, manufacturers of insulation for electronic and electrical applications under the tradename "Mycalex, The In-

J. H. DuBois

sulator"—announces the appointment of Mr. J. H. DuBois as Vice-President in Charge of Engineering.

Mr. DuBois was formerly Sales Manager of the Plax Corporation, a division of the Emhart Manufacturing Company. He brings to the Mycalex Corporation a wide experience in both the electrical and mechanical fields. He has held numerous key positions such as Manager of new product development for Plax Corporation, served the Shaw Insulator Company as Sales Manager, executive engineer and vice-president, was commercial engineer in Plastics for General Electric Company and engaged in pioneer plastics mold development work for the Gorham Company.

A member of the American Ordnance Association, Mr. DuBois has been associated with numerous important armament projects including radar, rockets, aircrafts, projectiles, chemical warfare and communications.

Mr. DuBois authored and cooperated in the writing of technical books and important periodical articles and is advisory editor for several journals. His books include "Plastics" 1st, 2nd, and 3rd Editions and he is co-author of "Plastics Mod Engineering." He is author and editor of the Motion Film "Origin and Synthesis of Plastics Materials" and holds two issued patents, and six pending patents, covering manufacturing methods and equipment for fabricating plastics.

Mr. DuBois is on the editorial advisory board of the "Journal of Plastics Engineers" and "Manual of Plastics and Resins." He is an active member, and a former National President, of the Society of Plastics Engineers Incorporated, and a member of the Society of the Plastics Industry, U. S. Naval Institute and the American Ordnance Association.

MOLDING of HEAVY SECTIONS

Gordon Thayer

Dow Chemical Co.

The four requirements for successful molding of heavy sections are discussed. Common faults in thick moldings and their causes are listed.

Definition Of The Term Heavy Section

A heavy section injection molded article may be considered to be one with section thickness greater than about one-eight inch. The molder finds different techniques are required to mold sections which are heavier than one-eighth inch in thickness.

The effect of the chilled skin of plastic next to the mold becomes less important as a flow resistance factor. The plastic breaks out of its envelope of chilled skin more and more readily as the thickness of section increases. These two effects are the principal differences noted between molding heavy sections and thin sections. These factors, however, are dependent upon how far the plastic must flow in the mold from the gate to the farthest extremity.

Furthermore, strength characteristics of the plastic article becomes less proportionally dependent upon thickness when the section is greater than one-eighth inch. Heavier sections have demonstrated in actual tests, lower tensile strength than thinner test pieces.

A heavy section of plastic may be encountered in a number of different places. It may be a heavy section by itself as the major portion of an article, such as a tool handle, hair brush back, or a toilet seat. The heavy section may be a minor portion of the molded article, such as a boss, a rib, a fillet, or a rim. The molding may occur as an isolated heavy section portion or an individual piece molded in a family mold of several dissimilar articles. Each of these occurrences of heavy sections presents its own group of factors involved in successful molding, but general considerations apply to all to a large degree.

Economic Factors

The weight of a heavy section molding of polystyrene is in a range which has made it difficult for the plastic to compete with several other engineering materials on a material cost basis. This is not greatly different from the conditions which were encountered with many thinner section applications of plastic, such as radio cabinets, refrigerator parts, and housewares. The adverse competitive position of plastics in these cases was overcome by applying more efficient molding methods which increased production quantity per hour, reduced reject losses, and produced more uniform parts of higher quality.

Recent experiences in molding heavy sections of polystyrene indicate material cost competition can be overcome in a similar fashion. Some of these experiences have been obtained in molding brush blocks, television cases, thick and thin parts in family molds, and ribs, bosses, and rims.

Difficulties Encountered in Molding Heavy Sections

A first step in attacking the task of establishing a dependable injection molding technology for heavy sections is to classify the commonly encountered difficulties. This can be done in two ways. A list of difficulties can be made up without regard to their cause. A classification of these difficulties can be made according to their relations to molding cycle variables. Both classifications have been made for the purpose of this study of molding heavy sections. Table 1 shows the first list which contains fourteen difficulties which occur at various times while molding heavy sections.

The next series of classifications relates these difficulties to three variables in the molding cycle—pressure, temperature, and time.

Table 2 lists difficulties which occur when plastic pressure is incorrect. It may be too low or too high, or it may vary between too low and too high which is the condition usually encountered.

Table 3 lists difficulties which occur when temperature is incorrect. Plastic temperature and mold temperature are involved, and these can be independently incorrect in various combinations. This classification shows only what happens when either the plastic temperature or the mold temperature alone is not what it should be. The combination of both temperatures being incorrect is not uncommon, but the four temperature combinations which would follow have been omitted for the sake of brevity.

Table 4 lists some of the difficulties which occur when the timing of various parts of the cycle is not prop-

TABLE 1

DIFFICULTIES COMMONLY ENCOUNTERED WHEN INJECTION MOLDING HEAVY SECTIONS

1. Long Cycles
2. Heavy Flash
3. Sink Marks—Bubbles
4. Warping
5. Surface Ripples—Short Shots
6. Silver Streaks—Surface Bubbles
7. Flow Lines—Folds
8. Weld Tails
9. Sticking, Scoring, Breaking
10. Crazing, Cracking
11. Non-Uniform Annealing
12. Low Heat Distortion Temperature
13. Varying Dimensions From Piece To Piece
14. Departure From Mold Shrinkage Allowance

erly adjusted. This is not a complete list by any means, but major difficulties have been pointed out.

The classification of difficulties according to their relation to pressure, temperature, and time can result in hundreds of mathematical combinations of conditions, many of which need not be considered because they are absurd. There still remain, however, many combinations which are not absurd, and the classification is good if the molding engineer can start from the right place to eliminate the difficulties.

This has been, however, too much like a log jam which molders have been pulling apart one log at a time with about the same results as are obtained by the same tactics on a real log jam. Usually when one log is removed, more logs fall into a new and possibly worse jam than before. It would be convenient if the key log in this molding jam could be found and removed first.

Because the relation of the difficulties to the variables appears to be so formidable and because it has not led to establishing a dependable technology, it may be better to proceed in another direction of attack. A definition of what is to be accomplished in producing heavy section moldings may prove to be helpful in developing methods of molding such parts.

TABLE 2

PRESSURE

PRESSURE TOO LOW
- Sinks—Bubbles
- Surface Ripples
- Short Shots
- Excessive Shrinkage

PRESSURE TOO HIGH
- Heavy Flash
- Warping—Long Cycles
- Sticking, Scoring, Breaking
- Crazing, Cracking
- Low Mold Shrinkage
- Low Heat Distortion Temperature

PRESSURE VARIES FROM HIGH TO LOW
- Non-Uniform Annealing
- Varying Dimensions
- High Scrap Losses
- Lost Time Between Cycles
- Incorrect Temperatures
- Incorrect Timing

TABLE 3

TEMPERATURE

PLASTIC TOO HOT
- Long Cycles
- Sinks—Bubbles
- Surface Ripples
- Silver Streaks
- Sticking
- Warping
- Burnt Welds
- Burn Marks

PLASTIC TOO COOL
- Flow Lines
- Folds
- Weak Welds

(At condition of Maximum lb. hr. thru Heater, Plastic is Both Too Hot and Too Cool)

MOLD TOO HOT
- Surface Sinks
- Long Cycles
- Warping
- Burn Marks

MOLD TOO COOL
- Calls For Over Hot Plastic
- Silver Streaks
- Weld Tails
- Difficult Annealing

TABLE 4

TIME

High Velocity At Gate	Jetting—Flow Lines
Too Rapid Filling	Burn Marks
Too Slow Filling	Folds
	Warping
	Crazing
Long Plunger Dwell	"Packing"—High Residual Strains
Short Plunger Dwell	"Discharge"—Sinks, Bubbles, Etc.

OBJECTIVES IN MOLDING HEAVY SECTIONS

The objective in molding a heavy section is to fill the mold quickly with the correct amount of plastic and to trap it there without forcing any more plastic to enter. This objective is made up of four requirements:

(1) Fill the mold quickly.
(2) Load the correct amount of plastic.
(3) Trap or prevent discharge.
(4) Avoid packing.

Filling The Mold Quickly

There are reasons for each of these requirements. It is desirable to fill the mold quickly in order to minimize the thickness of chilled oriented skin at the mold wall and the subsequent frozen strains of high magnitude. Frozen orientational strains have been described in other publications, and they will not be discussed at length here (1, 4).

Filling the mold quickly is a major requirement in order to allow the maximum degree of pressure equalization throughout the cavity. This can occur when the plastic is still fluid. Pressure equalization provides uniform density throughout the molding and is an important factor in avoiding sink marks and bubbles.

Loading The Correct Amount Into The Cavity

Loading the correct amount of plastic into the cavity is necessary to insure having sufficient plastic there to occupy the volume measure of the mold, less thermal contraction, after the plastic is cool. The plastic must be compressed when it is hot and fluid in order to accomplish this. It has been found polystyrene is compressible to the extent of 6.8 percent at 450 F. and 16,000 psi. pressure (5, 6, 8).

Improper compression of the fluid plastic is the cause of much difficulty in holding dimensional tolerances. Too much compression can result in shrinkage of .002 inch per inch or less from mold dimensions. Too little compression can result in shrinkage as high as .008 inch per inch or in bubbles and sink marks.

The correct amount of plastic in the cavity will exert the minimum required pressure on the mold walls. When this pressure is low, sticking, scoring, and flashing are minimized and usually are eliminated. The role of plastic pressure and its relation to sticking has been discussed in other publications and it will not be discussed here for that reason (8, 10).

Trapping The Mold Charge

Obviously, it is not sufficient to force the correct amount of plastic into the cavity if some of it is allowed to escape by flowing backward through the gate. Therefore, the third requirement has been stated as a necessity to trap the charge in the cavity. This has been seen in a motion picture study of injection molding (9).

Avoid Packing

Packing excessive plastic into the cavity after the correct amount is already there does several things which are not conducive to making a good molding. An excessive amount of plastic produces excessive pressure in the cavity

and this causes sticking, cracking, scoring, and excessive frozen orientational strains which result in crazing and warping (1, 4, 7). These defects have been outlined in Table 2 under the classification of molding difficulties according to pressure.

Special Considerations

The effect of variations in the amount of plastic charged into the mold cavity is an important consideration. It has been stated one of the requirements is to charge the correct amount. It may not be possible to achieve perfection, and it is not always practical to try to do so in this regard. Too much variation in the amount of plastic charged into the mold cavity, however, can be fatal as it has been found by experience.

One of the difficulties which comes from variation in the amount of plastic charged into the mold is poor response to annealing treatments. This is chiefly because of the wide variation in the depth and magnitude of frozen orientational strains. Some pieces from a given lot may be so highly strained that they will warp at a temperature which can effect annealing in a reasonable time. More parts from the same lot may not warp during the same annealing treatment, but will not be thoroughly annealed in the given time because of high strains. This results in too high a percentage of rejects after annealing, or in an uneconomically long annealing cycle at low temperature.

There is often a hidden effect of variations in the amount of plastic which is charged into the mold cavity. Parts can be molded with strains which are not easily detected at the molding machine. The range of apparently acceptable parts extends from just short of sticking or flashing to scarcely filled out. Sometimes only the median twenty percent of the parts so produced are actually satisfactory, although as high as ninety-five percent of them may be shipped out of the molding plant. When the improperly molded parts began to fail, it is often difficult for the purchaser to understand why some of the parts behave so well and others exhibit such poor properties.

One of the most important considerations in assuring the proper mold charge being placed in each cavity of a multiple cavity mold is balanced resistance of the gates. It has been found some of the molding schemes which will be described subsequently have failed to provide satisfactory moldings because the gate resistance was not balanced. Upon balancing, the several mold cavities filled out properly and produced pieces which were within their proper dimensional limits.

UNSATISFACTORY METHODS OF MOLDING HEAVY SECTIONS

Molders have been attacking the problem of molding heavy sections for a long time with inconsistent results. One of the chief reasons for the inconsistencies is that all four of the requirements listed in the objective have not been sufficiently satisfied simultaneously.

It may be well to review these four requirements and keep them in mind in the following discussion of molding schemes and the analysis of their ability to fulfill the four requirements simultaneously:

(1) Fill the mold quickly.
(2) Load the correct amount.
(3) Trap the charge.
(4) Avoid packing.

Analysis of some of these molding schemes shows one or more of the factors has been ignored, or it has been impossible to satisfy all of the factors because of the nature of the operation or of the equipment.

Large Gate

A large gate considers only one of the four factors. It allows the mold to be filled quickly. No assurance of placing the correct amount in the mold cavity is provided by the use of a large gate. Avoidance of discharge with a large gate usually results in severe packing.

Restricted Gate

When a restricted gate is used to mold a heavy section, it is almost certain the mold cavity will fill too slowly. It has been pointed out previously why fast filling is required. Furthermore, a restricted gate often results in jetting of the stream of plastic directly from the gate, rather than the formation of a broad flow front contained in an envelope of chilled plastic.

The restricted gate may trap the plastic in the mold well enough, but when the gate is thin enough to do this, the mold almost always will fill too slowly. If the restricted gate is thick enough for quick filling, it may be too slow in stiffening to trap properly, and packing will occur if discharge is prevented.

Furthermore, no assurance the correct amount of charge will be placed in the cavity is inherent in the use of the restricted gate.

Preheated Granules

Some molders have considered the use of preheated granules is the secret of success in molding heavy sections. This technique provides scarcely any recognition of the four requirements with the exception of some slight assistance in changing the fill time requirement. If the plastic is more uniform in temperature, as it may be sometimes when preheated granules are used, it will be easier for the plastic to come to equilibrium pressure throughout the mold. Thus, though the use of preheated granules may be of some assistance in molding heavy sections, it is not very effective by itself.

Mold Temperature Cycling

Mold temperature cycling has been employed in molding heavy sections with some degree of success. This has been accomplished by cycling the temperature of the injection mold from about 350 F. during injection to 150 to 200 F. for ejection. This method considers fill time requirements only. It has the effect of making the allowable fill time longer by almost completely eliminating the chilling effect of the mold walls. It does not take any account of charging the correct amount of plastic into the mold, and there is no inherent provision for trapping the charge without packing.

Preplasticizing

Preplasticizing is a good idea essentially, but usually this method of molding has ignored completely the four requirements for filling the mold, although it is not necessary to do so. Preplasticizing may result in lower pressure in the mold than the conventional plunger machine transmits, but even so, the pressure may be still too high.

Preplasticizing may be combined to advantage with a molding method which satisfies all four requirements simultaneously. It is beyond the scope of this discussion, however, to show in detail how preplasticizing can be applied to molding heavy sections. The subject is large enough to merit treatment by itself.

METHODS WHICH CAN BE EFFECTIVE FOR HEAVY SECTIONS

In spite of the fact such molding methods as the use of a large gate, a restricted gate, preheated granules, mold temperature cycling, preplasticizing, and others not mentioned do not satisfy the four requirements simultaneously, it has been found possible to mold some parts here and there which have been serviceable to some extent. It seems

safer, however, to adopt a molding method which comes considerably closer to satisfying the requirements.

Several molding methods and devices which have been tried at various times appear to be able to satisfy the four requirements well enough to produce high quality heavy section moldings at competitively low cost. Some of these methods and devices have not been developed far enough yet, but it is fitting to mention them because they can be adapted with some further engineering.

Nozzle Valves

Nozzle valves have been used in a number of different arrangements to cut off the flow of plastic into the mold, some of them at a suitable time to trap without allowing packing. Rapid mold filling can be accomplished through such valves because large gates can be used. The nozzle valve serves to trap the plastic in the cavity without requiring the gate to solidify quickly. Trapping can be accomplished with a minimum of discharge, or with no discharge at all for some nozzle valves. These devices can be operated with very little packing, but packing can be severe if timing of the valve closing is incorrect.

The weakest point in the use of nozzle valves is in measuring the correct amount of plastic. This must be done by careful control of granule feed, injection pressure, plunger time, and uniform cycling of the entire molding operation.

It has been found some nozzle valves can produce satisfactory moldings, although they do not achieve perfection in satisfying the four requirements.

Transverse Spool Valve

A transverse spool valve is shown in Figure 1. This illustration was made to show how one injection molding machine valve operates. There is some leakage of the plastic and there is some possibility of contamination. The slide valve is operated in this case by means of a hydraulic cylinder under control of a timer. The operating

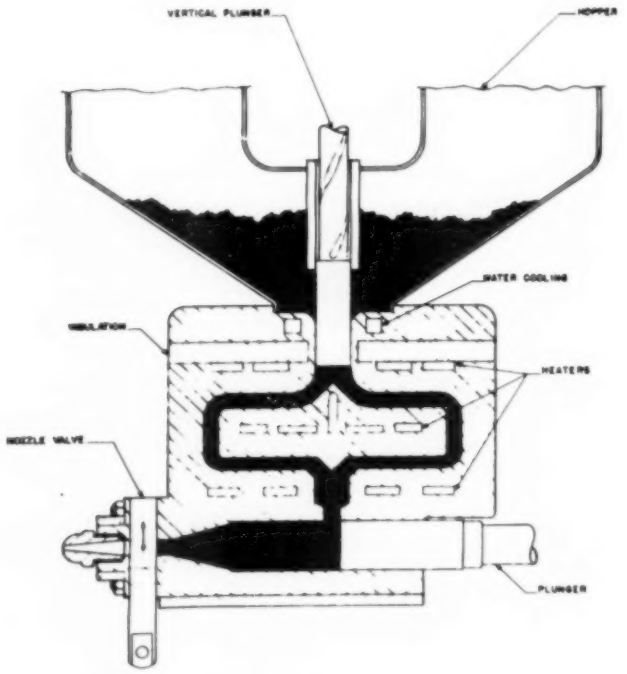
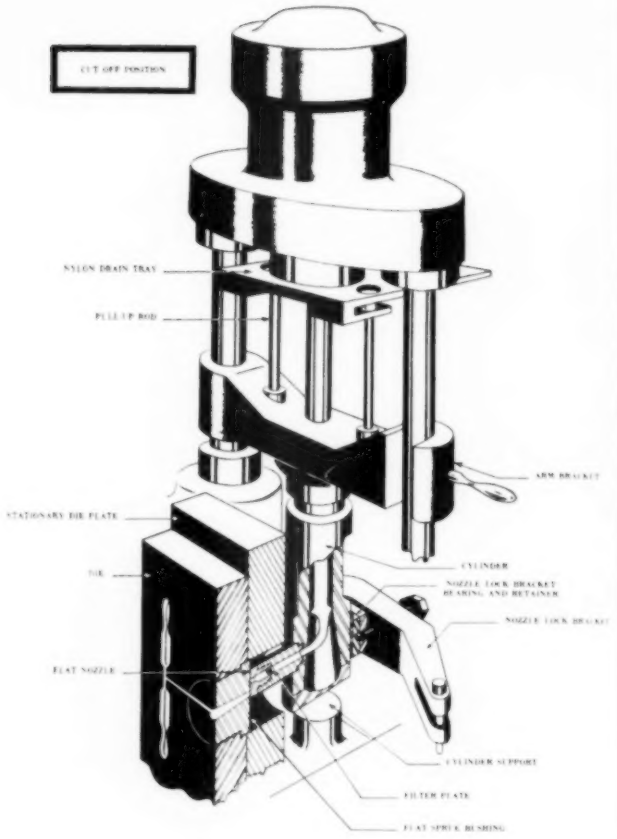


Figure 1. Transverse Nozzle Valve

Figure 2



DIAGRAMMATIC CUT-AWAY OF NYLON CUT-OFF ATTACHMENT

mechanism may be bulky and difficult to install near the nozzle without weakening the front platen of the press. This type valve has been used on several molding machines, and is expected to be more widely available.

Nozzle Cut-Off Attachment

A nozzle cut-off attachment is shown in Figure 2 which illustrates the Lester vertical injection heating cylinder. The Lester Engineering Company has patents (15) which cover the use of a flat face nozzle and sprue bushing for injection molding nylon and preventing drool from the nozzle. The nozzle face is moved across the face of the sprue bushing to disalign the holes and prevent flow of plastic in either direction. The chief disadvantage of this type of nozzle is its availability for use only on one type of machine.

This device has not been engineered for the correct timing of the nozzle displacement for heavy section molding. Such engineering probably can be done without much difficulty.

Longitudinal Spool Valve

Figure 3 is an illustration of a longitudinal spool valve taken from the Goessling patents drawings (12) which include special heating cylinders. The valve appears to be designed chiefly to hold the fluid plastic in the heater until it is desired to force it into the mold. The valve is held in the closed position as shown by a spring which pushes the valve stem and the nozzle forward. When the heating cylinder is pushed against the sprue bushing, the nozzle is forced back against the spring and this allows plastic to pass through the nozzle. Upon completion of the filling of the mold, the heating cylinder would need to be moved back enough to allow the nozzle valve to close

in order to effect proper trapping of the mold charge.

Dow Ball-Check Nozzle

Figure 4 shows one arrangement of the Dow ball-check nozzle which permits plastic to flow freely out of the heater into the mold, but which checks the reverse

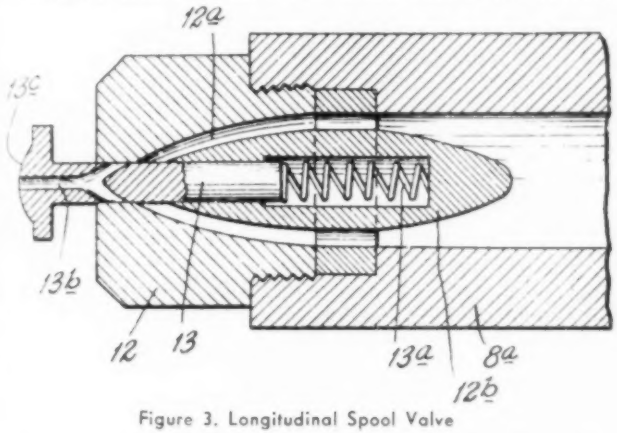


Figure 3. Longitudinal Spool Valve

flow as soon as a slight amount of discharge from the mold forces the ball against its seat (4). This nozzle has been employed successfully on polystyrene brush block moldings and on other heavy sections, such as television lenses.

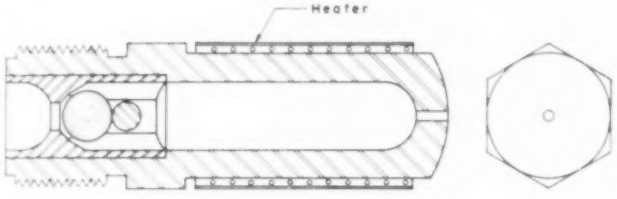


Figure 4. Dow Ball-Check Nozzle

The ball-check nozzle does not measure the amount of plastic charged into the cavity, but it has demonstrated it can mold heavy section parts reasonably well. Considerable care is required in adjusting the plunger time and other factors so as to avoid packing. This nozzle has been found to be convenient to use, but it is not easy to purge when color changes are required. The nozzle should have a heater which is controlled by a variable voltage regulator. Users of this nozzle are licensed by The Dow Chemical Company.

Gate Valves

Valves have been used at the gate of the injection molding at various times, generally for the purpose of degating rather than trapping the plastic in the cavity. However, such valves can be adapted for trapping rather readily.

Gate valves can satisfy three of the requirements which have been outlined for proper filling of the mold cavity, but they cannot measure the amount of plastic charged.

Figure 5 shows one example of a gate valve which has been published recently (11). This is a gate cut-off valve which is used for molding eight phonograph records per cycle. In the operation of this mold, the fluid plastic in the gate section is pushed out of the mold entirely as the gate opening is closed by pins. The injection nozzle is withdrawn simultaneously to allow the exit of plastic. Disposal of the plastic in the gate is a specific problem when a gate valve is used. This scheme represents a convenient solution, though it is not the only one.

It is probable gate valves may be good enough for many molding requirements, and their use is certainly an advance over some molding methods presently employed. Such valves, however, may be cumbersome or expensive, and the cost of the molds which employ them may be prohibitive in some cases.

Injection Pressure Control

The Lester Engineering Company has devised and patented a system for decreasing the injection pressure to a predetermined amount by means of a microswitch which is mounted to operate between the two halves of the mold (14). As soon as the pressure of plastic inside the mold cavity is sufficiently great to force the mold apart slightly, say .003 inch to .005 inch, the microswitch actuates a system of hydraulic valves to decrease injection pressure to a point at which no more plastic can be forced into the mold.

This system is most useful for large area moldings for which it was originally intended. The larger the projected area of the parts in the mold with respect to press capacity, the more sensitive this device will be. It is based actually upon a reaction to excessive mold pressure, and for this reason careful control of molding conditions is required to allow sufficient discharge to balance the excess packing which occurs as the mold is being forced open.

The use of injection pressure control has been found to be satisfactory in a number of instances. Trapping can be accomplished with less packing than is encountered in conventional molding practice, and the system can be recommended for molding heavy sections even though control over the amount of plastic charged into the mold is not as accurate as may be desired for some critical work. Considerable experience is available with regard to release of deep draw molded parts through the use of injection pressure decrease at the proper time.

Starved Feeding Of The Molding Granules

From time to time molders have discovered it is possible to trap the mold charge by starving the feed to the point at which the injection plunger exactly reaches the end of its stroke when the mold cavity is full. Starved feeding has been practiced with considerable benefit for several purposes, but not always with the realization of the four requirements which must be met simultaneously for proper molding of heavy sections.

One of the reasons for starving the feed is the pressure in the mold varies according to the distance of the plunger from the end of its travel when it stops. This variation in pressure can be as much as thirty-five percent as reported by Ziegler (2). If the plunger is allowed to travel to the end of the stroke, variation in pressure can be minimized, but this alone does not eliminate it.

Another reason for starving the feed is to allow high injection pressure to be used to overcome friction of the granules against the wall of the heating cylinder without

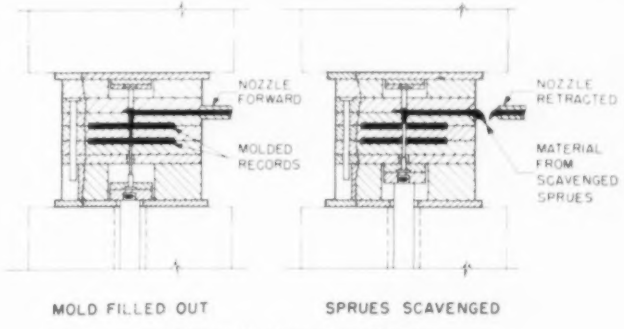


Figure 5. Gate Cut-off Valve

having excessive static pressure in the mold at the end of the plunger stroke. Friction forces in the cold end are considerable and have been described by Spencer, Gilmore, and Wiley in a study of behavior of granulated polymers under pressure (3).

Higher injection pressure during the injection portion of the cycle utilizes more power from the hydraulic system. More power during the injection stroke with other things being equal and otherwise satisfactory, means faster filling of the mold.

Greater availability of pressure during injection often allows less well plasticized material to be forced through the heating cylinder and thereby increases the possibilities for greater output in pounds per hour. Some recent information suggests considerable friction heat may be added to the plastic as it is forced through the cylinder (16). Availability of higher injection pressure may increase mechanical heating and thereby add to the heating capacity of the cylinder. The higher injection pressure is not converted to high static pressure in the mold at the end of the injection stroke if the feed is properly starved.

Starved feeding could fulfill all four requirements for heavy section molding if accurate measuring of the amount of plastic could be accomplished along with starving the feed. Filling quickly and trapping without discharge are inherent in the method or are easily provided. Large gates can be and should be used, and this helps satisfy the rapid filling requirement. Trapping without discharge can be accomplished by holding the plunger forward until the gate is sealed sufficiently to prevent discharge by itself.

If the correct amount of charge is placed ahead of the plunger and is trapped in the heating cylinder as the plunger passes the feed opening, an amount of material equal to this charge will be displaced from the nozzle end of the heating cylinder into the cavity. Packing will not occur, because after the fixed quantity of material has been pushed into the mold, no more plunger travel will be available to displace any more plastic.

It has been difficult if not impossible to starve the feed properly in volumetrically metered operations. This is because volumetric metering devices are not accurate, and most of them are arranged to compensate for over or under feeding. This causes a variation in the amount of plastic charged to the mold.

Furthermore, the best molding granules available are not of sufficiently uniform bulk factor to assure uniform quantity of granules each cycle. It is considered to be impractical to attempt to make granules having greater perfection than those presently being produced. Even if granulations could be made to feed perfectly when volumetrically measured, there is still the problem of adding reground material and feeding it.

Starved feeding with volumetric measuring has not been very successful, and it may well be responsible for some unexplained variations in the performance of apparently identical parts from the same mold. This is because the amount of plastic charged by volumetric feeding can be too much, just enough, or too little with about equal opportunity to be any one of the three.

Excessive scrap has been encountered also when the volume measured charge has been obviously too little as evidenced by a short shot, possibly one-tenth ounce short in a two pound molding. When the charge is too much in excess, crazing or breakage occurs and scrap also results.

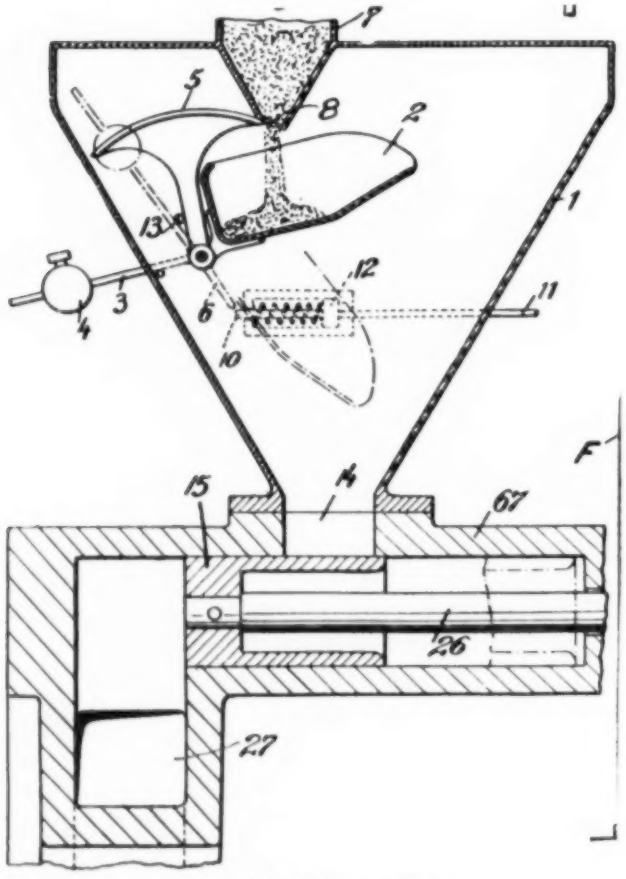


Figure 6. Weigh Feeding Device

Weighed-Starved Feeding

Starved feeding has been shown to be nearly satisfactory for molding, and it is the most nearly perfect method known to satisfy the four requirements if the feed is weighed accurately. This is not a new technique by any means. Emil Hempel obtained a patent (13) on a weigh feeding device attached to an injection molding machine. The patent application was made in Germany in 1938, to mention one such device. Figure 6 is taken from the Hempel patent drawing and shows his scheme for weighing the feed. Weighed-starved feeding has been employed to some extent recently for molding critical items, such as television lenses and other industrial parts. This method of molding may be required in order to meet some of the specifications which are presently being written.

Annealing is a requirement for some pieces such as storage battery containers. Weighed-starved feeding can result in uniformly strained parts of low magnitude of strain which can be annealed quickly and uniformly.

Brush backs, toilet seats, and deep draw parts are sure to be molded in increasing numbers by using weighed-starved feeding. It is expected these items will become large in dollar volume because this method of production will result in sufficiently low production costs to allow the plastic articles to compete with components made of other materials. The dependability of articles so molded will do much to assure their continued acceptance after high prices and material shortages have given them a chance to be introduced widely.

Plastics with special properties may expect to find wider uses when weighed-starved feeding is more widely practiced. Some of these materials are stiff in flow or rapid setting or otherwise too difficult to mold with present methods of controlling the molding conditions.

CONCLUSIONS

Four requirements for filling the mold during injection molding of heavy section articles have been described. The objective is to fill the mold quickly with the correct amount of plastic and to trap the charge without packing. Molding methods have been described which can take all four factors into consideration simultaneously.

The most convenient method, and the most accurate, is the use of weighed-starved feeding. This method is recommended most highly of all because of the high degree of precision in control which it affords.

A number of other methods of molding heavy sections have been described. Nozzle valves, gate valves, and pressure cut-off devices can be adapted to do a reasonably satisfactory job of molding heavy sections.

It is expected, however, wider use of heavy section moldings will require greater and greater precision in the control in the amount of plastic placed in the mold cavity. Such devices as nozzle valves, gate valves, and pressure cut-off devices will be useful for a number of molds which are in existence at the present time. They will show marked improvement in the quality of the product and in reduction of reject losses over the results which are being obtained with conventional molding methods.

No attempt has been made to describe the application of weighed-starved feeding techniques to preplasticizing machines. It may be pointed out all four of the requirements for filling which have been outlined must be met even though preplasticizing is employed.

Considerable experience must be added to what is now known in order to make these molding methods still more dependable. The list of commonly encountered difficulties which was presented earlier can now serve as a guide in making many of the adjustments which are required. The recognition of the four requirements for filling the mold is the key to molding heavy sections, and once these requirements are met by the molding method employed, the relations of pressure, temperature, and time to the molding cycle become much simpler to apply.

References:

1. "Residual Strains in Injection Molded Polystyrene," R. S. Spencer and G. D. Gilmore, Modern Plastics, December 1950.
2. Injection Molding Research Report No. SL476, January 1947, E. E. Ziegler, Report of The Dow Chemical Company (Unpublished).
3. "Behavior of Granulated Polymers under Pressure," R. S. Spencer, G. D. Gilmore, and R. M. Wiley, Journal of Applied Physics, 21, 527, June 1950.
4. Bulletin: "The Technology of Injection Molding, II—Nozzle Designs," Plastics Technical Service, The Dow Chemical Company.
5. "Equation of State for Polystyrene," R. S. Spencer and G. D. Gilmore, Journal of Applied Physics 20, 502-6, June 1949.
6. "Equation of State for High Polymer," R. S. Spencer and G. D. Gilmore, Journal of Applied Physics 21, 523-6, June 1950.
7. Bulletin: "Controlled Flow, Balanced Gating, and Other Considerations," Plastics Technical Service, The Dow Chemical Company. Presented at S.P.I. National Technical Conference, May 27, 1949 by R. W. VanSickle, G. B. Thayer, and E. L. Kropscott.
8. "Role of Pressure, Temperature, and Time in the Injection Molding Process," G. D. Gilmore and R. S. Spencer, Modern Plastics, April 1950.
9. "Photographic Study of the Polymer Cycle in Injection Molding," G. D. Gilmore and R. S. Spencer, Modern Plastics, April 1951.
10. Bulletin: "Fundamental Considerations in the Injection Molding of Polystyrene," G. W. Cheney, Plastics Technical Service, The Dow Chemical Company.
11. "Eight Phonograph Records Per Cycle," Clarke F. Galehouse and Hibber W. Moss, Modern Plastics, February 1951.
12. U. S. Patents 2,359,839 and 2,359,840 to Gerald A. Goessling. Assigned to Pro-phy-lac-tic Brush Company.
13. U. S. Patent 2,320,594 to Emil Hempel, Zerbst, Germany. Vested in the Alien property custodian.
14. U. S. Patent 2,433,132 to Nathan Lester. Assigned to Lester Engineering Company.
15. U. S. Patent 2,274,800 to Nathan Lester. Assigned to Lester Engineering Company.
16. "Basic Features Influencing the Performance of Injection Molding Machines." E. Gaspar, "Plastics Progress," Iliffe and Sons Ltd., Dorset House, Stanford St., London, S.E.I.

PROGRAM OF MEETINGS OF THE BUFFALO SECTION

May 16, 1952

"Plastics from the Consumers Angle"

W. H. Goodman	J. V. Vevirit
Modern Plastics, Inc.	The DUK-IT Co.

June 20, 1952

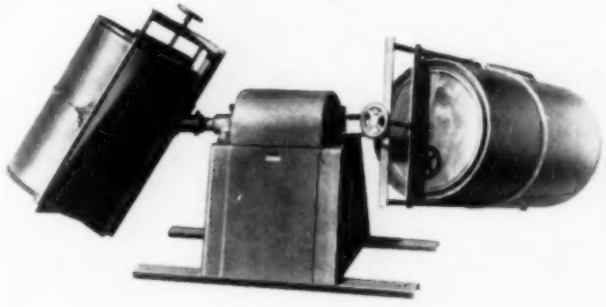
Plant Visitation

R. Bright	J. C. Cassidy, Jr.
Dubois Plastics, Inc.	Dubois Plastics, Inc.

IMS DRUM TUMBLER

Made Exclusively for

Dry Coloring Injection Materials For The Injection Process



Compact . . . Extra Power for Bigger Batches . . . Higher Speeds for Faster Mixes . . . Takes Most Std. Drums . . . New Adjustable Drum Holders

Price, crated, with ¾ HP 220-440 v. 60-cycle, 3-phase motor and adjustable barrel holders $452.50

F. O. B. Cleveland

Send for special bulletin giving helpful hints on dry coloring for the injection process.

Injection Molders Supply Co.

PENTON BLDG. CLEVELAND 13, OHIO

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

Injection Molding of Vinyl

Vinyl injection molding is a topic that is seldom discussed. Here are a few pointers that can help if you are faced with a vinyl job. The first question that always comes up is, "Do I need a special heating cylinder to mold vinyl?" You call on your good friends in the technical service departments of B. F. Goodrich Chemical or Bakelite or other supplier for an answer. Of course they say, "Yes, we recommend Duranickel or Hastalloy metal in heating cylinders which are to be used on vinyls as these metals will resist attack by free HCL."

Then you begin to look into the practical matter of actually getting heating cylinders of these metals. Delivery runs from 6 to even as long as 18 months, and the price runs from $3000 to $8000, even if you could get the unit. A top priority is suggested. So what to do?

Well, you can run vinyl in an ordinary heater, plated or unplated, and most molders do. Here is the story. Provided you **never** overheat the material, and never begin to break it down chemically by exposing it to too hot heater walls, it will run very nicely and give no trouble. There are several catches to this general proviso, however, and they must be thoroughly understood. The chief catch is that in rating an injection machine for molding vinyl, you must just about cut the stated rating in half. In other words, an 8 oz. Watson, Lester, Reed-Prentice or HPM is actually only a 4 oz. machine at best when we are talking vinyl molding with regular heaters. This means that you must know how to correct the published rating of your machine to its actual capacity to melt vinyl safely without ever decomposing it at any time. You simply cannot melt vinyl as fast as you can styrene or acetate. The heater has to be run at a far lower temperature—from 200 to 400 degrees below styrene settings. If you are trying to shoot 8 oz. vinyl on an 8 oz. machine in a regular heating cylinder you are almost certain to burn the material and eventually plug and possibly ruin your heater.

What happens is that the vinyl in contact with the cylinder wall chars and decomposes into gas and a carbon-like product that is a remarkable insulator. The charred material plates out on the heater walls, acting as an insulating barrier, necessitating a still further increase in heat, and there you have the start of a vicious circle which ends up with a plugged heating cylinder. So the answer is simple as that: just don't over-rate the capacity of your machine to melt vinyl SAFELY!

Now two things can and usually do happen if you try to overrate your press, or run a given job too fast on vinyl. I have mentioned the carbon-like deposits we observe. The other problem can be far more serious. If **any** moisture is present in the material, either surface moisture or combined moisture, it will unite with the normal decomposition products of vinyl to form free HCl which does two things. The free acid will eat holes in your heating cylinder, ruining it for running vinyl or any other material which will lodge and burn in the holes so produced. And if much of the gas is released into the molding room it can eat the dickens out of you, out of the mold, and the press. The two problems (carbon deposits and eating from free HCl) do not necessarily occur together in the same heating cylinder, but they may. I have seen evidence that if the carbon-like deposit appears first it may actually protect the heater against eating. But it also seems that if decomposition products are present in the heater, according to a well-known chemical law, they will assist in the further breakdown of incoming new material, and you are headed for trouble. But these signs of danger, (charring and gas) are simply signs that you have failed to estimate your heater capacity correctly IN VINYL, and possibly have failed to dry your material as completely as you should.

Comes now the matter of part finish in vinyl molding. This matter was brilliantly discussed by Frank Martin of Hoover Company at a Cleveland SPE meeting. The big point he made was in running his heaters at a safe low temperature, and then in adding frictional heat to the material by the use of pin point or restricted nozzles, runners, and particularly gates. We are all familiar with the vinyl part which is half shiny, half dull. This lack of finish I believe, is nothing more than cold, incompletely melted plastic entering the mold because the job is being run too fast on too small a capacity heating cylinder. Frank Martin in his outstanding work at Hoover Company on their vinyl parts (worthy of a Hyatt award if anyone is) discovered that he could improve part finish, part toughness and quality by lowering the cylinder temperature to within safe zones so that special steels were not required in the heating cylinder, and by reducing nozzle and gate size to within the extreme limits usually propounded for styrene. The material picks up enough frictional heat in the restricted passages to overcome some of the limitations in the heating cylinder, and to give the true gloss we should associate with correctly molded vinyl parts.

The use of a heated nozzle will also help improve vinyl part finish, provided a suitable controller is used on the heater band—as this has the effect of providing a longer exposure of the material to a safe heat.

Part Quality or Speed Records

I have around samples of injection molded parts purloined over the years from various molders, and about which I used to brag because they were molded at break-record speeds on machines I was trying to peddle. I actually bought some of these items for my own use. Now, today, some of these parts can scarcely be said to be a credit to our industry's ability to produce quality merchandise. Crazing, cracking, and warping (words often used in our slick trade journals to extol something that is never supposed to happen to thermoplastic parts) are common. Strain patterns are outlined in soot or dirt caught in hair-like cracks, and chipping from accidental dropping are painfully evident. Now I wonder if it is more important to break a speed record or mold a good part that will stand up in use? The molders are not wholly to blame. They merely want to run a machine as fast as it will cycle on every job. The real trouble lies in the heating cylinder, and the damage was done to the plastic during molding. You simply can't scorch styrene or any other plastic against a super-hot cylinder wall without causing eventual embrittlement and strains from the admixture of degraded material thus dragged into the deeper layers of plastic going through the heater. Some of these defects are seen as surface defects, and are usually discarded as scrap. The more serious defects are molded in, and only become apparent as the part ages in use.

I am in danger of sounding dull, dry and foreboding, like some of the editorials in our trade papers, but next time you hear some molder or machinery salesman brag about breaking molding speed records, pause and weigh

(Continued on page 25)

MODIFIED PHENOLICS

Wyman Goss

General Electric Co.

The specific properties of a phenolic resin can be modified by incorporation of the proper filler. Applications are many.

Phenolic resins in themselves possess excellent physical and electrical properties. By the proper selection of fillers certain specific characteristics can be achieved to meet product requirements where the ultimate in a specific property is of paramount importance.

Where high impact is required the conventional chopped fabric filler is used. Although impact is improved the molder experiences a more difficult and costly cleaning operation. The end user frequently has to sacrifice appearance standards and dimensional tolerances.

By this example it can be seen that in order to achieve the ultimate in a single property certain sacrifices have to be made in other properties or characteristics.

Another means of modifying the phenolics is to include in the manufacture of the resin, special materials to produce properties which are not possible to achieve by the use of the straight phenol formaldehyde resin alone. For example, furfural modified phenolics are used to obtain materials which mold satisfactorily on deep draw parts and in transfer molding. They can be used to improve water resistance, improve heat resistance, and have excellent dimensional stability when properly formulated into molding powders. Aniline oil is used to obtain superior electrical properties. Other modifiers include cresol and the various substituted phenols.

For some time it has been the exception rather than the rule to modify phenolic molding powders with rubber to unite the excellent properties of both of these materials and to overcome, as far as possible, the objection to either of the two products when compounded and molded.

Before synthetic rubber was developed, natural rubber was not as compatible as certain synthetics and resulted, at best, in non-uniform blends. The synthetics on the other hand are more compatible with certain phenolic resins and the resultant properties are quite unique.

Phenolic molding materials are inherently strong, but nevertheless, they are relatively brittle. Rubber, on the other hand, is soft and tough, and when combined with phenolics its resilience gives molding materials greater shock resistance and greater ability to withstand vibration and fatigue.

All of the properties of rubber phenolic materials are not improved upon. Some characteristics appear from standard data to be poorer. Nevertheless, the rubber modified phenolics do possess a combination of new and different properties than have heretofore been available in a single molding compound. A very important characteristic of this material is the modulus in flexure which is ¼ that of the unmodified material. That is where the abuse resistance of the rubber modified phenolic shows up. Specific gravity is lower (3.8), resulting in more parts per pound of material. Although the water absorption is greater, the appearance and stability are better after long time immersion than are the same properties of unmodified materials. The heat distortion point is about 30° lower on the modified material. Electrical properties are about equal.

The standard Izod impact strength of the woodflour-filled rubber-phenolic is about 1.7 times that of standard general purpose material. Actual experience, however, has shown that the modified phenolic will withstand from three to seven times more abuse than the standard phenolics.

Drop hammer tests more accurately reflect the ability of the modified material to take mechanical abuse. Often times the modified wood filled materials will stand up equal to or better than the unmodified flock filled phenolics. Likewise, the flock filled modified materials frequently replace unmodified rag material. The rag filled modified phenolic compound represents the highest impact strength of this class of material developed to date.

The modified material can be molded in existing molds in most cases by conventional techniques. The material can be dielectrically preheated; preferably hotter than general purpose phenolics and the cure time is usually only 5 to 10% longer. It is desirable, although not always necessary, that the molds be chrome plated. Gas venting, particularly in dead ends, is desirable. Standard finishing techniques may be employed. The machining properties are excellent.

The material will take inserts. However, it is recommended that deeper knurls be provided as the material is more flexible on hot discharge from the mold, as would be expected. It is also recommended that larger knockout pins be provided when there is any tendency of the knockout pins to penetrate the molding on extraction.

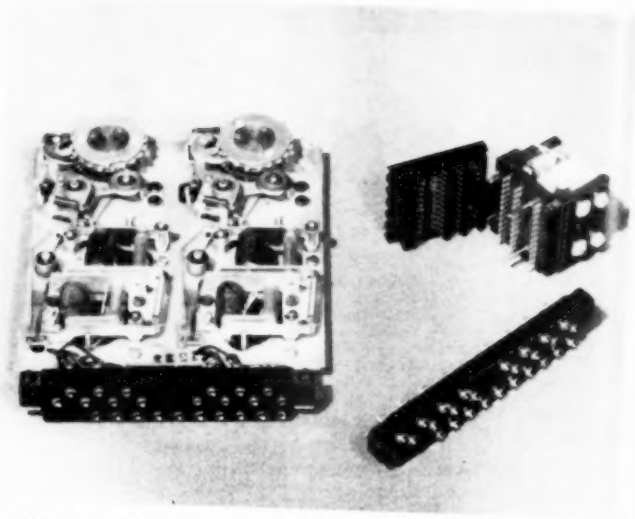
Some of the typical applications of the rubber phenolics will serve to illustrate the versatility and design features of the new materials. Several manufacturers have utilized the impact resistance and good electrical properties of the rubber phenolics for use on fan bases.

In addition to the application of the molding materials which you have seen, there is also available a new rubber modified phenolic varnish which will be of interest to the laminators.

The characteristics of the laminates are greater toughness, more resilience, and this new product will undoubtedly open up the same possibilities for new and improved applications to the laminators that the modified phenolic compounds have opened up for the molders.

It can be seen from the diversity of applications shown that the materials have characteristics which are applicable to and are being used in military requirements.

This impeller for an electric dishwasher is molded from an asbestos filled rubber phenolic material and the silverware basket from a woodflour filled rubber phenolic material. The part in the center is the original metal silverware basket which the molded part has replaced. The new designed plastic basket is much more attractive, does not mar silverware, and withstands the chemical action of the detergent as well as the extremely hot water used in automatic dishwashing. The impeller has recently been changed from a phenolic material to rubber phenolic in order to overcome the breakage which occurred when a piece of silverware was accidentally dropped into the bottom of the dishwasher. The new material also withstands the detergents and hot water required in an electric dishwasher.



This photo shows an example of the use of rubber phenolics in calculating equipment applications. In this application, it was required to press in the inserts shown and then solder connections to them.

The rubber phenolics have sufficient resiliency to resist the impact which occurs in driving in these inserts. Service of these units requires driving in of the inserts with a punch or hammer. The conventional materials failed under this type of treatment. The rubber phenolics not only have the necessary resistance to impact but also sufficient dimensional stability to enable the proper alignment of the inserts in the molded part and the proper alignment of the molded part to the calculating device.

The automotive field, after extensive testing, is beginning to use rubber phenolics in rather large quantities. Here is an example of two of the applications which are currently in production. The large piece is a steering column bracket for the Oldsmobile. The second part shows the piece after painting to match the interior of the car. In this case the plastic has replaced die casting and has sufficient resistance to impact and the resiliency required to fulfill the general vibration and impact requirements in automotive applications. The smaller part is an air gauge instrument case for the Ford truck. These are both the woodflour filled material.

Rubber phenolics possess another very interesting property as shown in this illustration. Due to their inherent resiliency and low modulus of elasticity, they are able to be molded around large inserts such as shown here, without cracking. Electric Service Mfg. Co. has chosen the rubber phenolics for use on their parts due to its ability to resist cracking around the large inserts necessary in the application and because of its extreme toughness, ease of moldability, and good electrical properties.

NINTH ANNUAL

TECHNICAL CONFERENCE

Boston, Mass. Statler Hotel

JANUARY 21-23, 1953

The San-O-Lok syringe is molded from asbestos filled rubber phenolic. It will withstand sterilization and is resistent to oils, foods, and chemicals with which it comes in contact. It stands up under rough usage such as dropping on the floor in hospitals where it is used. A very smooth surface is required for sanitary reasons.

A group of electrical insulating parts molded from rubber phenolic materials. The bus bar, designed to carry household currents, is molded of woodflour filled rubber phenolic and has an insert two times as heavy as the plastic itself. The average insulation thickness is 1/8". Molding around large inserts is a feature of the modified phenolic material whose elastic properties are excellent for insulating large current carrying inserts. The bus bar yoke is flexed in assembly and the strength was required to overcome fracture at the sharp corners of this part. A circuit breaker trip shaft also is another example of the ability of the rubber phenolics to be molded around inserts and withstand continuous fatigue in operation. The circuit breaker handle is an example of the abuse resistance of rubber phenolic material. This handle is used on circuit breakers which are mounted in industrial plants and in mines. Frequently the workmen throw the switch by hitting it with a club or some tool rather than turning it by hand and it required the rubber phenolic material to overcome this abuse.

Illustrative of applications in textile industry, this jute bobbin molded from cotton flock filled rubber phenolic material is less costly than wood. A redesign gave lighter weight. The use of plastics gave longer service life, resistance to chipping and cracking. Additional applications are a filling bobbin for loom shuttles, which is currently being evaluated and expected to be the next large application in the textile field. The winder finger and the cheese core assembly are currently in production. The requirements of textile parts are commonly known to be impact, resistance, chemical resistance, dimensional stability, and most important, low cost. As in the jute bobbin, a redesign can often times not only give lower cost but a lighter weight. Lighter weight reduces also the tendency of pieces to chip when they are dropped on the floor or thrown into tote boxes.

This is a stab-end circuit breaker. This assembly is slipped as a bus bar on an overload conduit the Flexipower system of the Trumbull line. The conductor guards serve as insulation as well as protection. They are subject to frequent abuse and were unsatisfactory when formerly molded from a conventional rag filled phenolic. The rag filled rubber phenolic material fills every requirement of the application, including the abuse resistance which was unsatisfactory in the conventional material.

The Weller soldering gun is one of the early applications of rubber phenolic. This brown woodflour filled handle gives better appearance and possesses a greater abuse resistance than its flock filled counterpart in the unmodified formulation. Rubber phenolic lends the necessary toughness to the application as well as possessing an ease of moldability and ease of cleaning in the ventilation holes shown. The assembly is made with drive screws and the nameplate is riveted onto the part.

The next illustration shows a collector ring molded from rubber phenolic material and containing a molded in brass slip ring. The brass ring is then swedged into the plastic while the part is cooling thus assuring that the brass is held tightly to the plastic. This unique design of the collector ring has been achieved by the Warner Electric Brake and Clutch Co. and the molding has been done by the Rockford Molded Products Co. In this case, the molded plastic has to take considerable mechanical stress, has to perform the electrical duties of the usual collector ring, and has to have sufficient dimensional stability so that the metal insert does not become loosened from the plastic on actual use.

The Bosch and Lomb goggles are molded from woodflour filled rubber phenolic, and were formerly molded from a standard flock flour material. The scrap due to riveting the protective screen onto the frame was greatly reduced when the rubber phenolic material was adopted.

THE PANEL ON

NEW APPLICATIONS AND DESIGNS of PLASTICS

Jean O. Reinecke

Below is a verbatim report taken from tape recordings of the panel on New Applications held at the 8th SPE Technical Conference.

Each speaker was allotted time to present ideas, and a discussion period followed.

Panel speakers were: Winfield Cooper of Bakelite, James Johnston of Chicago Molded Products, Erick Furholmen of Furvel, Jack Davis of Motorola, and T. F. Muckenfuss of RCA.

Panel Chairman was Jean O. Reinecke of Reinecke and Associates.

INTRODUCTION BY
JEAN O. REINECKE

With any industry that is as young and as progressive as the plastics industry, it is very natural that everything about it is swiftly moving, and of course there is a certain amount of turmoil connected with this speed. It has only been a few short years since all a man had to know about plastics was the difference between phenolics and acetates and perhaps that he shouldn't make under-cuts. Today, it is quite different and it is also difficult to keep up with the developments in new materials and techniques and everything connected with the industry.

And now, our first speaker,
WINFIELD T. COOPER

In the past fifteen years, as labor costs have slowly risen, the use of phenolic molded materials has also steadily grown in fields where wood once held undisputed preference because of the low cost of the basic raw material. This has occurred largely because of the saving of labor in the molding operation. It has taken place in the radio cabinet first and later in the somewhat similar, though much larger, television cabinet. Since we are probably not at the end of an inflationary spiral, it is only logical to expect that further use of phenolics will take place in these industries, which cost-wise have been closed in the past.

In order to help this trend along, several years ago Bakelite built a mold for a representative type of drawer so that this basic idea could be studied and demonstrated to interested and forward looking people in the furniture industry. These two drawers were molded as part of that project.

One drawer illustrates the use of a molded-in, closed front, to which hardware could be attached as is, or which might be painted so as to harmonize with the rest of a colored assembly, that is, of a color which might not be practical to mold in with phenolics.

The other, molded with an open front, or without a front, by means of an auxilliary sliding block in the mold, illustrates one, but not necessarily the only or the best method for providing a means for assembling a front of a different type of material, such as natural grain wood.

Both drawers incorporate molded-in rails along the sides which will permit smooth, accurate sliding of these drawers. Incidentally, this drawer molded of a general purpose phenolic, and supported on these rails, will support the weight of a 200 lb. man.

The use of phenolic material in this drawer permits certain rather obvious basic advantages over traditional material, such as wood or steel. Design features are possible which either would be not possible or rather expensive in wood or metal; the use of large fillets to strengthen the piece; the use of special partitions where a special purpose drawer is required in sufficient volume to justify the cost of building a mold that way. The use of tapered sides would enable or facilitate the saving of space in either shipping or plant assembly. Then, there is a noticeably lower noise level of these drawers in operating as compared with metal. A large office with a great many desks would certainly appreciate something of this sort.

There is greater dimensional stability under a wide range of conditions as compared with wood. No more distorted sacroiliacs on stuck drawers in the summer time. The elimination of sharp corners at no extra cost would make cleaning easy—a hit to a busy housewife with a light colored kitchen. The corrosion possibilities are nil, as compared with metal—a further aid to cleanliness and a selling point to the purchaser.

Incidentally, one large volume outlet for furniture was sufficiently impressed with these advantages, and they are toying with the idea of a new line of kitchen furniture using molded drawers and actually charging more money for the advantages of the drawers, while they are new. It seems likely that those branches of the furniture industry will be most receptive to the idea of molded phenolic drawers which are most susceptible to standardization of sizes and types. This would reduce to a minimum the number of molds required and increase the number of units that could be produced from that mold. The use of molded drawers would then likely place a premium reward on, and encourage, further standardization with accompanying further reductions in cost which should be most welcome in offsetting the continually rising costs with which our industry seems likely to be plagued for some time to come.

JAMES E. JOHNSTON

The expansion in our own industry is only beginning. The material suppliers have increased their production capacity. The molders, both compression and injection, have increased their production capacity. This means that we will all seek new markets to help take care of the expanding materials and facility expansion. It means also that we must do a better selling job. In order to do this, it will require improvements in designing of new applications. In other words, we should design for quality and longevity, rather than design merely in an effort to secure an order. I'd like to repeat that—we should design for quality and longevity, rather than design merely in an effort to secure an order.

These expanded facilities and requirements indicate that once again we will, in a large percentage of our contacts, be working with individuals and concerns who have not had ex-

perience with our materials. They will be looking to us for ideas and suggestions for the improvement of their products, or enhance its appearance, and naturally, for a reduction in cost. We must dig deeper into our experience and help them to collaborations with their engineering departments and ours, in an effort to develop products that will be a credit to them, as well as to the plastics industry.

In order to do this, we should thoroughly investigate their product, what they may expect of our materials, the function of their unit, what abuse it is subjected to and in short, make more than an average appraisal of the application, and then design and sell accordingly.

For some new applications, may I point out that the refrigeration industry still has a considerable number of parts that can be made from the various plastics materials? The air-conditioning end of the refrigeration industry is enjoying a boom at the present time that more or less parallels the boom enjoyed by the television manufacturers. There are grills and even housings for these units that can be made from our materials.

We have another industry that is expanding, the home dryer industry. No doubt we are all familiar with the fact that the advertising men now are saying that the "clothes line of the future is just for the birds." There are parts at present being made for this industry and in time we possibly will find a home dryer in every home in the land just as is the washing machine.

The radio—television industry is still contributing immeasurably to the advancement of the plastics industry. Who would have thought, four or five years ago that we would be producing television cabinets that range in weight from 10 to 40 pounds? Four or five years ago, it was more or less unheard of. This will reflect itself in an increase from other manufacturers who use products similar to the television cabinet in size, because they will realize that items of this size can be made successfully and economically from plastics materials.

In the past, our most successful applications for molded plastics have been in fields where we have not had to bring about any extensive changes in the industries themselves. Our applications have been largely in the nature of replacement. Our customers have used plastics in place of something else. While we have shown these industries a great improvement in products and lower costs, our customers have nevertheless followed their original merchandising and production methods with relatively little change.

Our big market for the immediate future, I believe, lies in certain fields such as the furniture industry, who have thus far limited their use of plastics because fuller utilization would require revolutionary changes in production planning and merchandising. We now have an opportunity to invade these fields. Let us not make the same mistake we made in World War II, the mistake of designing for the quick dollar, the immediate sale. Instead, we should concentrate our design effort with a long range viewpoint to develop the kind of applications which we will have with us for many years to come. Only in this way can we realize fully the tremendous possibilities which now lie before us.

MR. ERIK FURHOLMEN

I wonder if there is anyone who doesn't feel like I do, that in spite of all the knowledge and all the experience we have gained, that we would not gladly exchange most of that for the things that we don't know. When we follow the development of the plastics industry it has been one of tremendous progress and we are doing things today that just a short time ago we would consider impossible.

From time to time, some material or some group of materials come out which open up new horizons for applications.

There has been one material which has recently been brought out which opens some interesting applications, and that is the injection molding of glass filled plastics. Fiber glass is generally a new venture in the plastics industry. The molded product is very rigid, and has high impact and tensile strength. Its color range is practically unlimited although up to the present time the glass fibers are generally visible giving a somewhat streaked effect, especially in translucent parts. The surface finish lacks the high luster so common to most other injection or compression molded items when a highly polished mold is used.

Single fiber glass filaments are .00038 in diameter and have an ultimate tensile strength of over 300,000 p.s.i. The specific gravity is 2.57. Because of the high strength of fiber glass in polystyrene latex, it often is possible to reduce the wall thickness considerably below that of most compression molded high impact materials, and thus overcome the disadvantage of high specific gravity and material costs per cubic inch of the fiber glass resin. Fiber glass loaded approximately 70% by weight by polystyrene latex is obtainable for injection molding, either as mats, cut into cubes, generally about $\frac{1}{2}$" square by 1/16" thick, or in rigid strands about 1/16" in diameter and cut into short pieces $\frac{1}{2}$" or so in length. The actual injection molding procedure is quite similar to standard polystyrene techniques.

The reinforced fiber-filaments give great strength and it goes without saying, that in order to get a satisfactory piece it is necessary that the part be so designed that these filaments orient themselves in such a way that there is no concentration of pure resin in certain spots. This will defeat the whole thing, because no chain is stronger than its weakest link.

This leads to some very interesting and intensive thought required in products as well as mold design. It goes without saying that there must be a fairly uniform wall section and proper radii and avoidance of certain things such as molded threads, where the resin content may concentrate.

JACK DAVIS

I'd like to point out one specific thing that really bothers an engineering group such as ours in the use of plastics materials in cabinets.

We start out with our industrial designer, make a mock-up, present the mock-up to our sales department, and our sales department either buys, or does not buy the design. If they buy the design, we then turn the design over to our mechanical engineering group who have years of plastics experience, not as plastics molders, but in designing the various parts such as ribs, grills, and things for plastic cabinets. This mock-up as shown to the sales department does not include all the mounting supports or all the openings. The mechanical group, after looking at this mock-up gets an outlined drawing and a few detailed drawings for our industrial designer and we put it on a drafting board, which is called a layout drawing, to get all the chassis dimensions and cabinet dimensions so that they coincide and fit. When we design the print, prior to releasing our print for the cabinet and for the purchase of the tooling steel, we get in touch with our purchasing department and they in turn invite suppliers, plastic suppliers, or manufacturers, into the company, to send prices. A salesman calls on the Engineering Department, with either a tool man or his factory man, and we go over the details of this speaker grill, ribs, etc., and in many cases the tool man or the factory man will tell us what he can, or can't, do. After he does all of that, we then put the print back on the board and our print proceeds to go through what we call "issue O," which is completed print—no changes. Actually, if we keep on going as we have in the last 4 or 5 years, we are just going to forget "issue O" because we have been down to "issue Z" after we have released the finished print. And the reason for that is that most manufacturers after accepting the order, later tell us that they can't make the grill like we wanted to have it. Experiences like that have cost our company thousands of dollars because we have to go back to engineering, get on the board, make some changes and in most cases make a new "mock-up," and present the new mock-

up to our Sales Department. We might or might not get a rejection there. We lose weeks and weeks. The Sales Department usually, in an organization such as ours, doesn't know the entire operation. They don't know about deadlines as far as meeting dates for shows, for distributor meetings, and the like. Their giving us a negative on the second showing of the mock-up usually costs us 30 days. At times, we not only lose the 30 days, but if we miss our show dates, a company such as ours loses thousands of dollars in business. All because this one supplier didn't give us the information, or couldn't give us the information, before we released the print with the purchase order.

We have had other problems where one supplier would come in and tell us he could do it, then go ahead and complete the tools, and the cabinet will be made exactly, or as close to exactly as possible. A year later if we would like to use the same grill, and the purchasing department decides to have another plastics manufacturer make that same cabinet often the new molder can't make the grill.

We've also run into situations like this, where the design accepted by the molder proves impossible to mold without blemishes. The redesigning is very costly in time and money, and gives the engineering department a poor reputation.

TOM MUCKENFUSS

My idea is to present to you the buyer's viewpoint of some factors within the plastics industry that we as a group would like to see improved.

RCA was a pioneer in the use of plastics in the manufacture of radio cabinets and related plastics used in our equipment. Our first phenolic cabinet was produced in 1935 and weighed about one pound. Last year we merchandised a 24 lb. television cabinet. It's an interesting "aside" we don't use it any more. Today, every cabinet in our line of table model radios, portables and 45. r.p.m. record players is made of plastics.

Cabinets used in the interior of our consoles and television combinations, as well as all decorative and functional items, such as dials, knobs, and name plates are made of a selected plastic. In the interior of our sets, plastics play a very important part through their use as insulating materials and other miscellaneous mechanical applications. The radio—television industry is a very highly competitive field. We use hundreds of varied plastics parts because they help us be competitive.

RCA engineers and stylists have been aware for many years of the unlimited and varied applications for which plastics can be used. As a result of our leadership in the industry we have been responsible for many firsts in plastics involving complex designs that often tax the ingenuity of our supplier, but whether the designs have been simple or complex, we have been faced with some serious problems that I am sure you gentlemen can help us solve.

The time cycle involved to get a mold into production often interferes with our production and our production schedules, and it is quite expensive when it does. Tooling cycles are much too long. The period from the time a job is released for tooling until the mold is ready to go into the press, is sometimes as long as six months. It is also a peculiar thing how a so-called normal tooling cycle can sometimes be shortened when the customer is willing to pay a fancy premium and personally follow the job very closely. After the too-long tooling cycle is completed, we must wait until the molder goes through the varied and many growing pains to get the mold into full production. This can no doubt be attributed to many problems, differences in equipment, raw material problems, mold design, and last but most important, the thinking of the various molders and mold makers on how to design and mold a specific job. Our engineers generally know what can and cannot be done in the design of a part. We like to use the knowledge of the industry and therefore take the advantage of the slogan "use your custom molder's know-how." We very often call in the custom molders' engineers and technical assistants for advice before proceeding with the final design on a complex part.

From our observation, it appears that general agreement among the experts is very difficult to obtain. When you discuss specific details, peculiar situations arise often with the experts in the plastics field in direct disagreement on how to achieve the end result on a specific design. This problem is industry wide. It is one that can only be corrected by broader exchange of information among the various molders, engineers, and mold makers, towards a faster way to produce molds and also towards some semblance of standardization of molding techniques and principles of mold design. Both are badly needed in the industry.

The industry has made great strides in the past decade, but from the average customer's standpoint the present situation is not a very satisfactory one. Efforts on the part of different groups towards standardization have been effective but they have not even scratched the surface. Emphasis on industry expansion is very important but it appears that too much of the thinking is always towards bigger machines, larger plants, and larger castings. I know that you are all concerned over your customer, because over the long pull he is the person responsible for your expansion, and also helps to pay the bill. But, as the average customer, it appears that the points mentioned above are not keeping up with the plastics industry's tremendous expansion. To me, it can be resolved into two questions.

1. Is there a group, or an individual, making an effort to solve the problem of how to build molds cheaper and in a much shorter period of time? And, also build them correctly, so when we have them finished and have the mold, we have what we started out to get.

2. How, and when, will the material supplier, engineers, molders and mold makers, get together and present a united front and thereby eliminate some of the mystery in this business, so that your customer does not oft times find himself in the position of the dog chasing his tail?

The last point is quite important because many of your customers do not understand plastics and one sad experience can sell them **off** plastics for all time.

During the course of the SPE Education Program, Wednesday, Harry DuBois made a very significant statement which I think many of us let pass too lightly. He said "What the industry needs is a new approach." I'm inclined in many respects to agree with him. There is much work to be done and the few problems mentioned above only represent the outstanding ones that the customer faces. I hope that in some measure they present a challenge that will eventually produce the desired result.

N. W. Penn Notes

Paul Roche

We understand that Bob Kling has recently been appointed to the new post of Chief Engineer (Plastics Division), Erie Resistor Corp. Bob is well known as a heavy-weight on the engineering team and in the new organizational setup will no longer be splitting his time with the electrical division.

In the progressive expansion program of Byrd Tool and Mold Co. a "Keller" has just been added to the machine tool equipment, enhancing the flexibility of the shop as well as the capacity to handle larger type work. Jack Graham has just re-joined the engineering staff, Jack being known to the locals from his connection at Perry Plastics also (Jack—we'll have an application blank ready real soon).

Lee Berry (Quinn Berry Corp.) has just returned from a southern cruise, leaving the score tied for the season between Lee and his associate, Jim Quinn, with regard to forsaking the dubious Erie climate for the attractions of the warmer areas.

STRESS GREMLINS IN THERMOSETTING PLASTICS

H. M. Quackenbos, Jr.

Bakelite Co., Division of Union Carbide and Carbon

The residual stresses molded into a part may be high. Tensile strengths are usually reported which are not valid for a part undergoing long term strains. A proper evaluation of long term test data is needed in selecting the proper material for a specific application.

Introduction

The subject of stress and strain in rigid plastics is almost controversial. For example, you may meet two men who seem to know something about tensile strength. One says that tensile strength doesn't mean a thing. The other maintains that tensile strength is the most important test we can make. Often these two opinions are not as far apart as they appear to be. The trouble at the root of much of the controversy about stress is that people talk about slightly different things. In condemning tensile strength one man is thinking of its use is designing parts for a washing machine. While in approving tensile strength the other man is thinking of its value in quality control—that is, in telling how close one batch of BM-120 is to another batch.

It seems to me important that we be quite clear as to the various angles of approach to this subject of stress.

Four Men

Number one is the tester, or the man who runs the test. Running the test is his living—not a rich living but a living. He points with pride to the testing machine, talks about crosshead speed, and the like. He is often more concerned with the behavior of material in the laboratory than with behavior in the field in an actual molded piece.

Number two is the physicist. Tensile strength is a sacred concept to him. He loves it for itself alone. Like the tester, he too is sometimes not much concerned with reality—that is with actual molded pieces.

Next is the quality control man employed by the material producer. His job is to see that all batches of a certain material are as like as a pair of peas. You can appreciate that he is worried looking. He is interested in tensile strength because he uses it to tell him how similar his batches are. Now there is, of course, a connection between this activity and reality. The molder naturally likes a

H. M. Quackenbos, Jr.

uniform material. But that is only one of the molder's problems. He has also to design the molded piece so that it works. Here the quality controller can offer him no help. If the design is wrong and the molding is breaking then it's no comfort to the molder that all batches are alike and all moldings will break.

The fourth man is the man who produces or designs the actual molding. He is a composite of the molder, the designer and the salesman of raw materials; let's call him the molder in the future.

Now the molder doesn't give a fig for tensile strength, in [illegible] cases out of ten. In an ashtray, for example, you need a material that won't catch on fire when a cigarette is mashed on it and won't break into a thousand pieces when dropped on the floor. Tensile strength may enter into one case and the designer uses it to proportion his molding to withstand the stresses involved or to choose between the various materials. In one more case out of ten the molder thinks that tensile strength enters. Later he finds that a material with a low tensile strength performs better than a material with a high tensile strength.

Thus, there is a conflict in viewpoints between the laboratory man on one hand and the molder on the other. By laboratory man I mean the tester, physicist or quality controller. The laboratory man tends to attach great importance to a test result. He tends to be unaware of the realities that the molded piece must meet. He tends to put undue confidence in a few simple tests, in the tensile test, the flexural test, the Izod impact test and the 24-hour water absorption test.

The Molder

The molder, of course, is in touch with reality and generally, I believe, tends to discount the few simple tests I have just mentioned, although they are urged on him by the authorities in the laboratory. Using those tests alone the molder cannot account for many of the failures of molded parts —that is, Gremlins appear to enter.

Now this gulf between the laboratory man and the molder has tended to disappear in the past few years. The molder has been making larger moldings and he has been screaming louder than before if the moldings turn out unsatisfactory. These screams have reached the laboratory and the laboratory man has brought forward modifications of the old tests, and has developed new test information. For example, creep tests have been made in which the load is kept on the specimens for weeks, months and even years.

Laboratory Tests

Let me now discuss some laboratory tests—not as a laboratory man interested in the behavior of a material in the laboratory but as a laboratory man hoping to present some laboratory tests from the realistic viewpoint of the molder. And, further, with the hope of showing how some of the past mystery of failures can now be explained and, in the future, can be avoided.

Let us start with tensile loading and consider four simple examples in which tensile stresses enter.

In a spinning bucket, synthetic fibre is gathered into a hank and water is squeezed out through holes by cen-

trifugal action, the bucket spinning at 7000 rpm. The effect of spinning at 7000 rpm is to stress the wall of the bucket in tension. Next consider a metal insert. In cooling from the molding temperature the plastic tends to shrink more than the metal. The result is that the plastic is under tension. Third, when a bottle cap is tightened tension is set up in the wall of the cap. Last, is a plastic container holding water. The water tends to swell or expand the fibres at the inner surface while the dry outside surface tends to remain as it is. Out of this conflict come stresses. The dry outside is under tension, the wet inside is under compression.

Insert Stress

Tension stresses enter in all these examples and the temptation is to analyze the examples in terms of tensile strength. Thus, if the bottle cap is breaking in service you would find another material with a higher tensile strength. This approach will get you into trouble because other factors enter.

In the insert for example, the stress is maintained for a long time, in fact for the life of the molding. The spinning bucket may be spun for several hours, the hank removed and the bucket started again. Essentially, stress is maintained almost continuously. A bottle may remain capped for days, for weeks or even months. The container may hold water for a long period and again stresses are maintained for that time.

Remember now, that in ordinary tensile loading the load is applied in one or two minutes and the breaking stress for general purpose material is about 8000 psi. If the specimen is hung up under a stress of only half this—4000 psi—it will fail in a few weeks or months. The stress that can be endured for years is smaller yet. This long-time stress is about one third of the tensile strength for phenolics; it is usually 1500 to 2500 psi. With styrene polymers the long-time strength is only one-sixth to one-eighth of the short time tensile strength. That is, it varies between 1000 and 1500 psi.

Long Term

From these figures for long-time strength you can see how far off you would be if you analyzed the bottle cap, the spinning bucket, the container and the insert in terms of tensile strength rather than in terms of long-time strength. You would be in error not only in the safe stress that can be allowed but you would make a mistake in assessing the strength of various materials. The thermoplastics with a high tensile strength have a low long-time strength.

More is known about residual stresses in metals than in plastics.

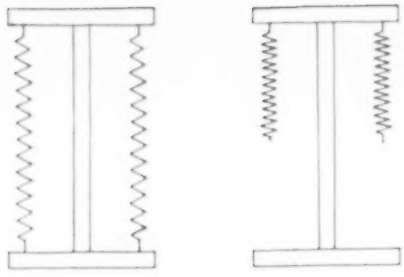


Figure 1. A. System under stress B. No stress

Kettering of General Motors was one of the pioneers. He found a way of strengthening and increasing the life of crank-shafts and other moving members. His methods seemed peculiar at the time. He shot-blasted or sand-blasted the metal member. Later it was proved that the strengthening was connected with the residual stresses induced by the treatment.

A structure under residual stresses is shown in Figure 1A. If the springs are released they come to their natural length, Figure 1B. Within the structure they're under considerable tension and the center rod is, of course, under compression. A similar condition of residual stress might occur in a section of a steel crank shaft, or in a plastic specimen.

The model of figure 1 shows how to reveal and measure residual stresses. A section is freed by slicing it off and the change in dimensions is noted. The model has only three fibers whereas a specimen of steel or plastic has a cross section consisting of a multitude of fibers. The effect of slicing is, therefore, slightly different in practice from what it is in the model. For example, a brass rod that has been cut down the center with a band saw shows a marked separation as in Figure 2. In the original rod there must have been a considerable stress holding together the two halves. The plastic bars so far examined have been small and the deformations are not large enough for a striking demonstration.

Figure 2. A Brass Rod, Sawed, Shows Residual Strains

The model also shows how residual stresses can strengthen or weaken. Suppose the model is loaded so that one of the springs is pulled in tension. The spring will snap or break prematurely because it is already under tension when the loading starts; some of its capacity to resist loads is already taken up. The residual stress thus weakens the structure in that area. On the other hand if the model is loaded so that the spring is compressed the residual stress has a strengthening effect. Part of the applied compression is taken up in offsetting the tension present before loading started.

In Kettering's crank shaft the rain of shot compressed the surface and induced a residual stress. This was such as to strengthen the shaft against the surface tensile stresses that caused failure. Residual stresses in metals have been studied extensively and cases of weakening and strengthening have been observed. Further, something is known about controlling these stresses; if weakening they can often be removed by annealing and sometimes favorable or strengthening residual stresses can be induced.

Plastics

We are just beginning with plastics. A few measurements have been made with phenolics. It is found that with a standard test bar residual stresses may be present to the extent of 3000 psi and they can raise the flexural strength about 10%. We know nothing yet of the occurrence of residual stress in molding nor do we know how to control these residual stresses nor how they originate.

Residual stresses may be important in molded objects. You should appreciate too that residual stresses introduce one more factor of uncertainty in translating laboratory results to the field. A laboratory test bar may not have the same strength as a molded part containing high residual stresses.

The absorption of water by phenolic moldings may have several effects that bring grief to the consumer. One, the material may expand and the expansion may destroy close tolerances and cause failure. For example, in a proposed water pump the impeller was to be of plastic and the casing of metal, Fig. 3. The material first suggested would have expanded .06" which is 2%. The clearance between the casing and the impeller was only .02" and this material would have caused a **slight** reduction in pump efficiency. Two, an effect that springs from expansion comes into play when one side of a molding is wet and the other is dry. For example, a lid on a vessel filled with water is exposed to this wet-dry condition. The fibres in contact with the water vapor tend to elongate, the dry fibers tend to remain the same

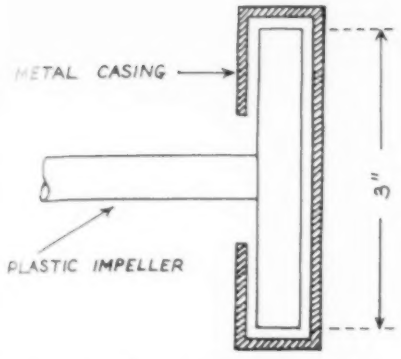


Figure 2. A Plastic Water Pump Impeller

length. The lid accommodates these tendencies by warping, the wet side becoming convex. This happened in a washing-machine lid molded from the wrong phenolic and the application was a failure. Three, another aspect of expansion in water arises with a vessel filled with water. The inside wet fibers tend to elongate; the outside dry fibres tend to remain the original length; the conflict produces stresses. These stresses may be measured with an electric gage or by the spring apart of the cylinder on cutting after exposure to water.

In a rayon plant thread was being wound on a phenolic cylinder and was sprayed with dilute acid. The outside of the cylinder was wet; the inside dry. The stresses arising were such as to crack the cylinder after several months' use. A wiser choice of phenolics would have eliminated this trouble.

Facts Did Not Exist

Perhaps it is unfair to talk of a wiser choice because at the time, several years ago, the facts for a wise decision did not exist. At that time a man faced by problems of water absorption might look for an answer in published test information. The only data he would find would be the weight gain of a disk immersed for 24 hours in cold water. This weight gain is .6% for a general purpose material and 1% for a fabric filled material. Even if our man were Einstein himself he could scarcely deduce from these results anything about expansion, warping and stresses. He might have made the best of it, however, and reasoned that the fabric filled material absorbed more water and therefore warping, expansion and stress would be more pronounced. These conclusions may be quite wrong. The 24-hour test reports the position at the end of the first lap in a race between a hare and a tortoise. Over longer times the tortoise goes ahead and the positions are reversed. The general purpose material takes up 8% of water to saturation and the fabric filled takes up 5%.

It was found that essentially the whole sum of information about water absorption can be expressed fairly simply in a few numbers and a few graphs. With these it is easy to calculate water gain, expansion, warping and stresses. You can do this for any time, temperature and thickness of sample.

Illustration

I will just indicate how you can use these calculations in the three examples of water absorption just discussed. The water pump will be full of water during its life and evidently the impeller will eventually reach saturation. The initial clearance between impeller and casing is .02". The woodflour material absorbs 8% of water and expands 2% or .06" and it would be ruled out. High impact fabric filled material takes up 5% of water to saturation and expands 1.3% or about .04". This material would be no good too. The asbestos heat-resistant phenolic absorbs 2% of water and expands .5% or .015" and could therefore be considered for this application.

In the washing machine lid, the period of exposure is a little difficult to judge. At the worst it might be two or three days if the housewife were lazy and did not take care of the machine before that time elapsed. It is possible to calculate the degree of warping for this time of exposure for several materials. A suitable phenolic for the job can then be chosen.

This is one place where thickness counts. The thicker the plate or lid the less the warping. Similarly, thin lumber warps worse than thick lumber, in a given atmospheric condition. Thus, if you expect bad warping you may be able to offset it by using a thicker plate or lid.

Wet-Dry Cylinder

In the wet-dry cylinder there is good agreement between the predicted curve of stress time using the principle we have evolved and the stresses actually measured. With a medium impact material the stress soon reaches a level of about 5000 psi. If maintained long enough this stress will cause cracking. With a general purpose material the stresses may reach a still higher level.

In fact, for a wet-dry exposure of long duration where stresses are caused, we cannot recommend a general purpose material. The only materials we can suggest for evaluation are the mineral filled phenolics (heat resistant and electrical grades).

Laboratory Tests

Laboratory tests have different uses and different meanings for different people. The physicist and the molder may not look at these tests with the same eyes. I believe that many mysterious failures and disappointments have come about because the molder got poor advice. His adviser spoke from the laboratory viewpoint rather than the practical viewpoint and, moreover, had not enough information to cover the numerous complications of molding reality. Now more information exists and some of this was covered in discussing long-time loading, residual stress and water absorption. The molders can use this new information with confidence. He can use it with the hope of avoiding in the future those mistakes that cost him in the past.

Now! New & Larger Quarters
At 554 Eben Street
NEW HAVEN, IND.

MORE DESIGN FACILITIES
(PRINTS TO 42" WIDE IN OUR OWN OFFICE)

MORE DEVELOPMENT AND
SHORT RUN FACILITIES

SAME P.O. ADDRESS: BOX 55 FT. WAYNE, IND.
NEW PHONE NO. 5273 NEW HAVEN, IND.

Let US Be

YOUR extra hand

Preplasticizing Symposium Is Presented At Meeting of Western New England

W. S. Larson

Summary of Preplasticizing Symposium, Society of Plastics Engineers, Western New England Chapter, March 5, 1952; participants, Mr. Sanford Glick, Monsanto; Mr. Sherwood Young, Church Manufacturing; and Mr. George Whitehead, Improved Paper Machinery Corporation.

Mr. Whitehead spoke first on preplasticizing machinery.

The molding of heavy sections is most benefited by plasticizing. It is necessary to keep the preheated material under pressure; this requires a check nozzle on the preplasticizer cylinder. Keeping material under pressure prevents gas bubbles. The requirements of a good preplasticizer are: heating capacity, heat and pressure control, delivery at proper rate during injection dwell, delivery under pressure (maximum 15,000 psi). The injector cylinder should hold two to three mold shots and serves as a tempering pot for the material before molding. Mr. Whitehead felt that there are no appreciable limitations on preplasticizing, especially for volume, and that all materials including nylon can be preplasticized.

Mr. Glick spoke on preplasticizing requirements on materials. Without preplasticizers there would be no large parts. It is also an aid to dry coloring. Crown Tool, in 1947, was one of the first companies to offer preplasticizing machines; there are now probably 35 to 45 types of preplasticizer. Sizes are offered from 4 to 300 ounces. An early trouble was discoloring from pushing against hot materials with the injector ram. One of the first attempts at preplasticizing was the making of battery cases by melting the material in separate pots which were then squeezed empty into the mold. Examples of products now being molded are 10-pound battery cases and refrigerator inner doors. White materials can be preplasticized. Acetate-butyrate has been run experimentally with a preplasticizer. Better results are obtained with dry coloring and bigger pieces (1400 to 1800 square inches) are made. A former rule of the thumb was two tons' clamping per square inch; with preplaticizing, one ton or less has been used. Better dimensional control and strain-free pieces are achieved along with faster cycles. The disadvantages are more difficult surging, more difficult starting-up after cycle interruption, and difficulty in molding mottles.

Mr. Young spoke on the molder's story on preplasticizing. The Church Manufacturing Company started in 1949 making their own preplasticizing and injection units. At that time contamination on light-colored materials was the big handicap. One answer is a beryllium copper plunger on the injector ram and a controlled leakage past the ram. The injector ram must be hot at all times; a cold plunger would chill the hot melted material. Church have found that thin sections require the same clamping pressure as before. They have run Tenite I successfully in production. The Church machine doesn't use any valving on the material. The preplasticizing cylinder is run very hot and the injection cylinder is run at a holding temperature. The nozzle is made with four small holes instead of one large hole. The preplasticizing cylinder feeds in one shot rather than pumping. It is mounted at 45 degrees and fills full each time. A 6-ounce cylinder customarily delivers 12 ounces. They have trouble starting up after a cycle delay and therefore use special sprue pullers. On $8\frac{1}{2}$-inch square wall tile on conventional machines the tile is 19 mils narrower on the end opposite the sprue. The preplasticizer corrects this. They can make marbleized tile, but it is somewhat different from the conventional mottle. Mr. Young felt that large parts, such as 600-ounce, are capable of being molded but will be too fragile for most practical uses.

WEST NEW ENGLAND

E. J. Sweeney

The April 3rd Dinner Meeting of the Western New England Section of the S. P. E. was held at the Hotel Sheraton, Springfield, Massachusetts.

Plans for the May Dinner-Dance and the Golf Outing in June were discussed during the brief business meeting.

Mr. Ed Child, Program Chairman, presented the speakers. Mr. Albert Stover of Naugatuck Chemical Company showed movies and talked on extruding and blow molding of vinyl film. Mr. Ralph Hanson spoke on marketing aspects of vinyl film.

A short discussion period followed.

Biography Of Thomas Edwin Orr

Last month's notice of the demise of Thomas E. Orr went to press before his biography could be included. His biography is presented here.

Born in Wheeling, W. Va. April 9, 1894, son of Joseph Reed Orr and Mary St. Clair Orr of Hamilton, Ohio. Educated in the Pittsburgh Public Schools and graduated from Central High School; B.S. in Civil Engineering, Carnegie Inst. of Tech. 1917, Civil Engineer 1944. Employed by American Bridge Company Panama Canal and Latin America 1911-12 and in the United States 1912-13. Upon completion of his college work in 1917 he entered the army, trained at Fort Niagara, N. Y. and served in France attaining the rank of Capt in in the 316th Infantry the 79th D ision. For some years following he served in the Reserves of this Regiment and it remained always very high in the list of his activities. He served as President of the Veteran Officers for two terms. Soon after his return from France he became associated with the American Gas Accumulator Company of Elizabeth, N. J. and continued as a stock holder with this company although he formed his own organization in Pittsburgh in Civil Engineering. The Highway lighthouse and the Lighthouse Service Company have home offices in Pittsburgh. In 1940 he became interested in the field of plastics and moved to Cleveland, Ohio, where he was vice-president and secretary-treasurer of Plastic Engineering, Inc. In 1948 he became president of Plastray Corporation of Detroit and its affiliate Plastray Ltd. of Canada, and Plastray Ltd. of England. He held various posts in national and international plastic organizations among these The Society of Plastics Engineers of which he was past president and an honorary life member. In May 1942 he entered the Air Corps with the rank of Major and served both in this country and overseas until April 1944. His awards for military service in World Wars I and II included:

World War I Victory Medal with 3 Battle Clasps, Medaille de St. Mihiel, Medaille de Verdun, Penna. World War Service Medal, American Campaign Medal, European-African-Middle Eastern Campaign Medal with 2 Battle Stars, World War II Victory Medal, Distinguished Flying Cross, Air Medal, Purple Heart with Oak Leaf Cluster, Medaille Militaire (France), 316th Infantry Outstanding Service Medal.

Among his connections at the time of his death January 29, 1952, were Chairman Class of 1917 Carnegie Tech, Member Engineers Society Western Pennsylvania, Ohio Professional Engineers, Pittsburgh Advertising Club, Society Plastic Engineers, Citizens League, Chamber of Commerce, West Side Industrials (Lakewood, Ohio), Disabled Emergency Officers World Wars, Purple Heart, American Legion Veterans of Foreign Wars, 316th Infantry Association, Beta Theta Pi, Tau Beta Pi Fraternities, Free and Accepted Masons, Presbyterian Church, Cleveland Athletic Club. His homes were 12506 Edgewater Drive, Cleveland 7, Ohio, and Hazelhurst, Wisconsin. He was the third of a family of four brothers, Newell Hamilton Orr, an executive of the Steel Industry now connected with the U. S. State Department in Germany; the late James Duncan Orr of Short Hills, N. J. and New York, long prominent in banking circles; and Dr. Louis Mahon Orr, physician and surgeon of Williamsport, Pa.

SUCCESSFUL DESIGNING for PLASTICS MOLDING

By W. M. Halliday

Simplicity of cavity formation, location of parting line, and proper provision for cores are important considerations in mold design.

The following general component-mold design features should be constantly in view throughout the stages when the exact character and form of the finished component is being finalized in readiness for commencing mold designing.

(A) Simplicity of Cavity Formation

In the first place, it has to be remembered that a cavity shape of the reverse form to that required on the finished molding will have to be machined, cut or otherwise produced within the steel mold. This latter must comprise at least two main members or blocks, matched up on one face, known as the parting line, in order to permit full access whilst machining in the requisite cavity formations. These latter may be contained entirely within a single mold block, or partially within each member according to the particular shape of the component.

For this purpose the shape of the molded article must be of such a character to permit this machining, often of a most complicated and precision nature, to be performed accurately, as simply as possible and economically.

In cases where portions of the cavity area have to be formed in each mold block, questions of accurate matching will arise for the toolmaker, and here again the shape of the component adapted in accordance with due consideration of this point may often conduce to simplified construction.

Unless precision matching of cavity portions is accomplished, there may be the risk of producing components misshapen at certain points on their surface, or dimensionally inaccurate. Such risks will be particularly apt to occur in the case of parts of intricate configuration.

(B) Location of Parting Line in the Mold

The necessity to split the mold construction in the above manner to facilitate construction also means that parting-lines and the plane or planes on which they will be located on the component, will have to be judiciously considered and throughly understood whilst settling the final shape of the component.

This will become necessary for the following reasons:—

(a) To produce the least amount of flash formation upon the surface of the molding. With both forms of molding manufacture, owing to the pressures employed, the position of the parting line in a mold will always be reproduced as a slight marking or flash on the sides of the component. As a mold wears from continued use this flash line will tend to increase, perhaps to the stage of unsightliness.

(b) The parting line in the mold must be chosen in such a manner as to ensure the location of any resultant flash on the molding in the most accessible place for subsequent removal by trimming tools, or alternatively to ensure that it will be situated upon a surface not essential for the appearance of the part.

(c) The parting line in a mold design must also be selected with a view to the simple ejection of the finished molded article.

(d) The parting line must also be situated in such planes or locations on the mold to permit it being readily opened after each set of articles has been produced.

(e) Mold parting lines must also be of the simplest shape in order to ensure a close seal being made over the whole area. For this latter object straight partings, in a single plane, are the best from the toolmaker's point of view. Irregular partings often incur considerable trouble during endeavours to match up the respective mold blocks in a sufficiently exact manner to obtain a close sealing contact over the affected area. This requirement will be particularly important in the case of injection molds, where no leakage can be permitted across the parting line surfaces.

(C) Coring Provisions for Holes

Most compression and injection molded components have usually to be produced with a number of holes, slots, openings or hollow internal formations of one kind or another.

These are nearly always reproduced in the mold by means of steel core plugs mounted in one or both of the mold blocks. Such cores may be affixed permanently within the mold, or carried in a reciprocating slide, or housed within a rotatable cylindrical rod carried in suitable bearings in the mold. In the case of such movable core plugs, special actuating mechanisms designed for manual, or mechanical operation may have to be introduced into the mold construction.

By molding-in such holes, etc., a number of extremely important advantages can usually be obtained. These advantages may be very closely associated with the finish obtained on the surfaces of the component, its strength features and its accuracy. Certain advantages will also be derived by the mold designer, and during the actual production of moldings when the tool is put into production service.

Considering the component first, intelligently planned coring will not only prove valuable by eliminating the need for subsequent drilling or milling on the component, but will also permit the amount of material to be maintained at the minimum level. Thus the cost per piece may be substantially affected and considerable economies gained. Material weight embodied in the component must, however, be related to the strength characteristics required in the part to withstand service conditions.

The quality of surface finish on the component may also very often be much improved by wise coring and the selection of suitable internal shapes lending themselves to economical reproduction. This advantage will accrue by reason of the reduction or even the elimination of undesirable shrinkage stressing and effects which would occur if large masses of material were concentrated at certain points on the article.

Heavy sections in a component to be produced as a compression molding, for instance, might have a tendency towards under-curing and weakness in the completed article. Similarly with injection moldings, thick sections may possess considerable porosity in the internal structure, coupled with surface sinks, and perhaps cracking tendencies associated with the thinner sections abruptly joined to the heavier portions.

The mold designer, too, will also derive considerable assistance from the use of cores in a mold. For example, it is often necessary to construct the mold in such a way that the finished component will always adhere to either the movable or the stationary mold block; usually it is the former member. This is necessary to permit the component to be ejected quickly and effectively and safely from the mold. If core plugs can be used and arranged in the proper manner for this purpose, very reliable working of the mold will be ensured and the whole ejection procedure simplified to a great extent.

The designer also very often relies upon core plugs projecting into the cavity area to promote a better flow of the plastics material therein. This is especially the case with compression molds. The size and location of the cores in relation to the remainder of the cavity configuration is, indeed, often of paramount importance in this regard, and in designing practice it is

(Continued on Page 28)

MIAMI VALLEY

By John L. Russell

Miami Valley officers, left to right—Ralph Backscheider, Secretary; Merle Nelson, President; C. Selz, Vice-President.

Ed Wimmer, Vice-President, National Federation of Small Busines, Inc., was the principal speaker at the April 3 meeting of Miami Valley Section, held at Eaton Manor in Hamilton, O. Dinner preceded the talk. Present were 23 members and 6 guests. Ralph Backscheider served as Program Chairman. Robert Gray, Dimco-Gray Co., won the good fellowship award.

Mr. Wimmer is a former candy manufacturer, who for 20 years has fought monopolies. He is a radio commentator of national reputation and a speaker of great renown. He devotes his time in helping to establish free enterprise and favors constructive competition in business. His very interesting talk was titled "Independent Business in Tomorrow's Market Place."

President Merle Nelson announced that the May 1 meeting as planned by Program Chairman Marty Kasch will be a dinner meeting at the Peerless Pantry, Miamisburg, O. The membership is looking forward with great interest to the showing of the Dow Chemical Co.'s color film "What happens inside an injection molding die." A Dow Company speaker will talk on the film and amplify its contents.

In June of course is scheduled the 6th Annual SPE Picnic at Terrace Park Country Club, Terrace Park, O. Already busily engaged in mapping plans are Jack Baxter, Merle Nelson and Joe Merke and Ralph Backscheider.

Rochester Section Points Out Advantages Of Regular Attendance at Section Meetings

C. F. Van Epps

I would like to review the current-year's technical programs to date and call to your attention the following discussions held at our regular monthly meeting thus far:

1. **January.** "The extrusion of polyethylene and nylon for wire insulation." George Peck reviewed the development of a complete plant and many of the technical and practical problems involved.
2. **February.** "Silk Screen process printing of Plastics." Ray Rueby Sr. The current emphasis on plastic decoration and one of the most widely used methods of printing on plastic was described in detail.
3. **March.** "The new Epoxy Resins." Mr. Houghton described the physical and chemical properties of this newest family of synthetic resins and pointed out samples of their many new uses.
4. **April.** "Teflon as Packing Insulation."

Looking over the above, it is evident that no simpler way exists to keep informed of the latest developments in the rapidly expanding plastics field than attendance at monthly meetings of the SPE. Keep in mind this is your society. Your officers are trying to provide programs attractive to you. Your comments are at all times welcome.

May is the month for our Annual Party and your committees are at work on this project now. As in years past, tickets will be printed and distributed for you and your friends. We again solicit your assistance with door prize donations.

Please feel free to call me or any other officer at any time regarding the operation of your Society.

New S.E. Ohio Section Has Members from Nineteen Companies

James Hoag

The Southeastern Ohio Section of the Society of Plastics Engineers held their regular meeting on Thursday, March 20th, 1952 at the Berwick Hotel in Cambridge, Ohio. 53 members and guests were present. They had as their guest speaker Mr. J. Gordan Seiter from the F. J. Stokes Machine Co. Mr. Seiter's subject was Vacuum Metallizing of Injection Molded Parts. He very thoroughly covered the description of the process, the practical applications in the plastics field and the equipment required. After a brief discussion on the fine points of the process, the meeting was adjourned.

It might be interesting to note that out of the 53 men present, there were 19 companies represented, namely, Fabri-Form Co., Ohio Plastics, Meridian Plastics, Inc., Continental Can Co., Triangle Tool Co., Central Plastics, McCreary Motto Co., Shellmac, Cambridge Tool & Die Co., Lincoln Plastics, Catalin Corp., National Bank of Cambridge, Jax Plastics, Moldrite, Cambridge Molded Plastics, F. J. Stokes Machine Co., Monsanto, Louis Marks Co., General Elec. Co.

Frecker Is Manager

Appointment of **Harry M. Frecker** as manager of commodity sales for the mechanical goods division, United States Rubber Company, was announced today by W. A. Tipton, sales manager of the division.

In his new position, Mr. Frecker will have direct charge of all commodity sales departments for such mechanical rubber goods as conveyor and elevator belting, V-belts, flat transmission belts, printing rolls and blankets, tank lining and roll coverings, hose packing, plastic products, molded rubber specialties, tape, industrial rubber mountings and matting.

Tindall Appointed Sales Manager

W. L. Tindall has been appointed Sales Manager for the combined operations of the Art Roil Leaf Stamping Co., plastics hot stamping specialists, and the Art Marking Specialists, Inc., using the decorating processes of offset printing and silk screening methods.

The SPE directory is in preparation. Do we have your correct mailing address and company affiliation?

Cleveland Hears Fiberglas Talk

S. S. Caldwell

The Cleveland-Akron Section met March 31 at the Spanish Tavern, Brecksville, Ohio. The program for the evening was in the form of a panel discussion on polyester-Fiberglas molding. Mr. Steve Hiltebrant of General Industries served as moderator. The speakers were Dr. Maurice Bigelow, Director of Research for Plaskon, and Mr. Roger White, President of Glastic Corp. Mr. George Hammond of Owens-Corning Fiberglass was also scheduled to participate, but due to illness, could not be present. The program was introduced by showing a short film on Fiberglas molding through the courtesy of Owens-Corning Corp.

Mr. White discussed briefly the techniques of compression molding "pre-mixes" of polyester and chopped Fiberglass. He emphasized the newness of this type of business and the importance of proper engineering of the application. He stated that by properly studying a given problem, the high material cost can often be overcome so that these materials can be competitive.

Dr. Bigelow discussed the Plaskon Alkyd 440 molding compound, stressing particularly its heat resistance, arc resistance and impact strength.

Following the talks, the speakers answered numerous questions on molding techniques, properties, and costs. The attendance was the largest of winter, indicating the interest in this subject.

Quality Control Is Topic At Philly

A. J. Kissileff

For the fourth consecutive month, attendance remained high at the combined meeting of the Philadelphia sections of SPE and the Society of the Plastics Industry (SPI).

The local SPE President, George H. Koch, Jr., introduced Mr. E. W. Birney, vice president in charge of production at Consolidated Molding Products, Scranton, Pa., as the evening's speaker. Mr. Birney has been associated with Consolidated since 1937. His subject dealt with "Quality Control by Statistics."

According to Mr. Birney, by sampling a production run at periodic intervals, variations can be plotted on a chart to arrive at an average control [illegible] of tolerances. This average is then recorded and periodic checks are made against the established check [illegible]. This method of control, said Mr. Birney, has enabled his company to accomplish two basic steps; first, to arrive at a definite formulation of the problem; second, to reach a definite conclusion as to the solution of the problem.

Almost invariably, Mr. Birney continued, when a frequency distribution check has been made, and the degree of acceptable tolerances established, it has been found that 68% of the production falls within a standard deviation of plus or minus one degree, 92% within plus or minus two degrees and 98% within plus or minus three degrees.

For most products, concludes Mr. Birney, the simplest method of establishing Statistical Quality Control is a random selection during the process at periodic intervals, charting the percentage of rejects for defect control purposes. Upper and lower control limits may easily be worked out from the results of this random check.

President Koch announced plans for future meetings, stating that April will be devoted to addresses on Beryllium Copper and Chrome Plating of molds. The May meeting will be one of the most exciting on record, covering the Reinforced Plastics field. Well known speakers are scheduled, and to highlight the event, a 12-foot Reinforced Plastic Boat will be presented to some lucky door prize winner. Other prizes, also of Reinforced Plastic will be given away.

Outstanding Programs Please Buffalo Section

R. H. Rushmer

We have recently enjoyed two very successful meetings, the programs of which we considered to be outstanding. We are passing this information along so that other chapters can be advised.

Our February meeting was addressed by Mr. George Herbert Bancroft, Distillation Products Industries, Vacuum Equipment Department, Rochester, New York. His talk dealt with the various phases of vacuum metalizing of plastics and all metals, which involve both the automotive emblem and metalized toys or other plastic articles where the metalizing is required to be over the whole first surface of the unit. Mr. Bancroft is a very capable speaker, knows his subject, and the presentation with the assistance of kodachrome slides was very good.

At our March 21 meeting we were addressed by Mr. Fred L. Zumstein of the Plastics Machine Division, Fellows Gear Shaper Co. Mr. Zumstein came to us from the Detroit Office, 323 Fisher Building, Detroit 2, Michigan. He showed two movies; the first on the development of gears, and the second, "The Art of Generating." His subject for discussion following the showing of the pictures was, "Molded Plastic Gears." Among other phases Nylon helical gears were given particular attention. Mr. Zumstein is a very entertaining speaker, knows his subject thoroughly, and presents it excellently. The meeting was, as usual, held at the Park Lane Restaurant in Buffalo.

Chicago Sees Film On Orlon Development

M. A. Self

The March 12 meeting was attended by only 34 people, since a goodly number of the Chicago members were attending the S.P.I. Convention in Philadelphia. Mr. Martin Shaw of E. I. DuPont's Thermoplastic Sales Division in Chicago was commentator for the showing of DuPont's film "Story of Research." This gave the story of the development of Orlon from the test tube stage to the completed fiber and its application in textile fabrics. Another film, "The Smooth Approach" was also enjoyed, and it is expected that all those members attending the plastics show in Philadelphia will fall behind in the forthcoming golf outings inasmuch as they will not have the advantage of the help of the experts as presented in this film.

The days of June 20, 21, and 22 have been set aside for the first Stag Golf outing of the year at Nippersink Golf Club in Nippersink, Illinois. A couple of tickets to one of these outings can be classed as a "Good Buy" since the link fees, your dinner and the prizes are covered therein. All members and their guests are welcome, so get your reservations in early.

Tom Cleavenger, formerly of Koppers Company, has recently been appointed Chicago Regional Sales Manager for Anesite Company. They do not as yet have plastic pipe in the "Big Inch" size, but Tom reports they'll have something close to it before long. Tom is our Chicago Chapter Program Chairman.

Molderscope

(Continued from Page 12)

the possible consequence of undue haste against our industry's reputation as quality producers of durable goods and wares. Shall we have new speed records—or part quality? We cannot have both, but that day is fast approaching. In preplasticizing—and in the starved-weighed feed used on conventional machines with improved heaters lies the answer to achieving part quality—with speed!

HIGH VACUUM METALLIZATION OF PLASTICS DISCUSSED AT CONNECTICUT

David Mersey

The March meeting of the Connecticut Section took place in Bridgeport on the 21. The April meeting is being moved to New Haven.

The serious portion of the meeting was turned over to Mr. Everett Brown of the Distillation Products Industries, who read a well prepared paper on, 'High Vacuum Metallization of Plastics'; and was ably assisted at a slide projector by Mr. Don Deyle, also, of DPi. This was substantially the same paper that was read at the recent SPI Exposition at Philadelphia.

High vacuum metallization is the evaporation of a metal under reduced pressure to a base material for the purpose of producing a metallic or highly reflectant surface. Aluminum is the usual metal used because it is inexpensive, and it also leaves a non-tarnishing film. Three types of patterns applicable in the field of plastic decorations, are:

1. 'Rear surface evaporation,' as in escutchions, name plates, panels, etc.
2. Metallization of non-rigid film.
3. 'Front surface metallization,' as in, toys, novelties, jewelry, etc.

The technique is essentially the application of a sandwich to the plastic surface, i.e., the aluminum is sandwiched between two coats of lacquer. The first or base coat is applied directly to the surface of the plastic part and serves as a sealing or filling-in undercoat. The high vacuum necessary for applying the aluminum is produced in a chamber which is evacuated by a series of pumps. The aluminum is boiled and evaporated from a coiled tungsten filament which is heated electrically. This process follows the application of the undercoat and preceeds the application of the top coat of lacquer. Varying degrees of brilliance can be obtained through the use of lacquers under the evaporated metal film while the durability and range of colors is controlled by lacquers on top of the metal film. The possibilities run from water white to gold or copper metallics, or any color of the visual spectrum.

Numerous slides in black and white, and color, were used to show; complete installations, diagrams of piping and valves, production flow diagrams, work carrying devices, lacquering equipment. Also, color photos of sequins, toys, jewelry, escutcheons, etc.

Many reasons were given as to why a great success is expected of this process.

Forty guests and members were present for this gathering; this includes the first appearance of a woman at any of these meetings. All we can say is, 'do it again'.

NEW YORK HEARS AUTHORITIES ON WAGE STABILIZATION, COST ACCOUNTING

Panel of Experts Formed to Solve Members Problems

Arthur M. Merrill

Despite inclement weather the March 19 meeting of the New York Section was attended by 60 members and guests. Held at the Gotham Hotel, the meeting included a cocktail hour, dinner, business meeting, and technical session. Two speakers were featured at the technical session: Harry H. Rains, labor relations consultant and professor of industrial relations of Hofstra College, spoke on "Wage Stablization Regulations—Their Effect on Small Business;" and William Nussbaum, SPI accounting consultant, discussed "Cost Control in the Plastics Industry."

Professor Rains gave an interesting review of current wage stabilization regulations, with emphasis on those affecting general wage increases, merit increases, promotions, and bonuses. It was emphasized that the regulations provide for flexibility, and in this respect are superior to those in effect during World War II. Penalties for violations are severe, despite the fact that most violations are based on ignorance. Most violations, however, can be corrected by consulting experts in the field. The great need is for industry to properly administer the regulations itself, and thereby avoid unnecessary difficulties, the speaker declared.

Mr. Nussbaum's talk dealt with the problems common to both engineers and accountants in the plastics industry, and described how the services of both are necessary for the setting up of proper cost control systems. Closer cooperation between engineers and accountants, and a proper understanding by management, are needed to set up uniform accounting practices and achieve standardization of cost control in the industry.

President Bruno E. Wessinger, Wess Plastic Molds, Inc., presided over the meeting, and Irving Rubin, Robinson Plastics Corp., acted as program chairman in the absence of Harold Schwartz, Empire Brushes, Inc. During the business meeting reports were heard from the various committee chairmen.

A panel of experts has been set up to assist members and guests of the Section in solving problems which may arise in their plants. Panel members and their fields of information are as follows:

Compression Molding: Sam Silverkraus (Riverdale Laboratory), and Nichols V. Fasano (Washington Molding Co., Inc.).

Injection Molding: Saul Blitz (Norma Electric Corp.), and Mr. Schwartz.

Moldmaking: Mr. Wessinger, and William Lewi (Dusal Tool & Mold Co.)

Materials: Thermosetting — Guy Martinelli, (Sylvan Plastics, Inc.), and thermoplastic — Richard Thews (Monsanto Chemical Co.), and J. Martin Voegtlen (Celanese Corp. of America).

Assembly and Finishing: Stanley Bindman (Jamison Plastics Corp.), and Samuel S. Stone (Nordan Plastics Corp.)

Research Applications and Testing: Harriman H. Dash (Arma Corp.).

Table favors were distributed through the courtesy of H. G. Jacobs Mfg. Co. and Rotuba Extruders, Inc., and the meeting closed with a drawing for door prizes contributed by Dusal Tool & Mold Co., and Nordan Plastics Corp.

The next regular dinner meeting of the New York Section will be held on April 16 at the Gotham Hotel. Featured speaker will be Louis J. Buhler, Buhler Service Corp., who will discuss "Accidents in the Plastics Industry—Their Prevention and Cost."

Four new members were added by the Section during March, as follows: J. S. Brody, president of Franklin Jeffrey Corp.; Robert Doyle, chief of research for Chester Packaging Products Corp.; Leon Lautin, president of Lautin Plastics; and William Hogenson, Jr. sales engineer for Stanley Sapery Co.

FORT WAYNE HEARS ROYALITE TALK

John Groesbeck

At our March meeting, approximately thirty members and guests were present for the technical session held at the Chamber of Commerce in Fort Wayne. A movie, **The Origin and Synthesis of Plastics Materials**, prepared by the Boonton Molding Company, was shown, followed by an interesting talk on Royalite by Mr. L. R. Weiss of the Royalite Division of the United States Rubber Company. The door prize, a deck of Kem Plastic Playing Cards, was donated by Barrier-Pribble, Inc., and won by Dr. E. T. Rainier, Plastics Development Division, United States Rubber Company.

The next meeting was held on April 4 at the Chamber of Commerce. The speaker was Mr. W. F. Condon, Owens-Corning Fiber Glass Company, who spoke on the use of glass fibers in reinforced plastics molding.

DETROIT ACTIVITIES

Emil R. Gazdick

The March meeting of the Detroit Section of the Society of Plastics Engineers was held at the Rackham Memorial Building. Mr. H. E. MacArthur of the Conforming Matrix Corporation, Toledo, Ohio, spoke on the subject of "Masking Problems On Hand and Automatic Spray Painting."

This subject is timely due to the increasing demands for escutcheon and nameplates, Mr. MacArthur's talk was of extreme interest followed by a lively question and answer period.

Our section president, Harry Haaxma, has appointed the following committee chairmen for the coming year.

Program Committee — Mr. John Totten — Ford Motor Company.

Membership and Credentials — Mr. W. DeGalen — Koppers Company.

Finance Committee — Mr. Eric Ericson — Detroit Plastic Products.

Educational Committee — Dr. E. Tillitson — Wayne University.

Historical Committee — Mr. Fred Conley — F. Conley Company.

Publicity and S.P.E. News Reporter — Mr. E. R. Gazdick — Evans—Winter-Hebb, Inc.

Announcement is made of the appointment of Messers. Don F. Hoffman of Evans—Winter-Hebb, Inc., and John Totten of Ford Motor Company as co-chairmen of the Professional Activities Committee.

Of local interest is the announcement by Plastics Specialties Company, Inc., Trenton, Michigan, that Mr. Jefferson W. Ellis has been appointed to head up their laboratory. Mr. Ellis, a graduate of Wayne University, who was formerly with U. S. Rubber Company, will be in charge of quality control and products development of resin impregnated fabrics, papers, and fiberglass fabrics produced by Plastics Specialties.

TOLEDO MEETS

Robert F. DeBrock

The Toledo Chapter of the SPE held its March meeting on March 18 at the Duraglas Center, Toledo, Ohio. The regular meeting was preceded by a Board meeting, which included the officers and chairmen of the various committees.

The speaker of the evening was Mr. Edward F. Borro, of Durez Plastics & Chemicals, Inc., who spoke on "Closed Mold Molding Techniques." A booklet on this subject is available on request from the Durez Co.

A buffet lunch was served following Mr. Borro's talk.

The following officers have been installed for the current year: president, W. E. Fillmore, Owens-Illinois Glass Company; vice-president, David L. Cordier, Plaskon Division of Libbey-Owens-Ford Glass Company; secretary, D. R. Bowlin, K & M Machine Company; treasurer, Herbert W. Pi- Reliable Machine & Tool Com-

Photo A shows a preform obtained during the course of routine manufacturing operations at the plant of a leading plastics molder. Since delaminated preforms such as this represented too high a percentage of total preform production, a remedy had to be found.

Photo B shows a preform obtained from the same molding compound, handled by the same preform machine, after Metasap Calcium Stearate had been incorporated into the molding powder.

With the addition of the Metasap Calcium Stearate, it was found that preforms could be ejected with *less than 25%* of the pressure formerly required. As a direct result of such reduction in pressure, delamination was practically eliminated.

Many manufacturers today are finding that Metasap Zinc and Calcium Stearates not only assure perfect preforms, but provide other important benefits. For example:

with preforms — **molding can be done with machines of less tonnage, and molding materials are conserved.**

with finished products — **output is increased, because molded pieces are easily and quickly released from molds; and rejects are decreased, because clean-cut, more marketable end-products are obtained. Also, mold life is lengthened, since scoring is avoided.**

If you stress precision fabrication, especially from intricate molds, you will find these advantages offered by Metasap Zinc and Calcium Stearates exceptionally profitable.

METASAP CHEMICAL COMPANY, Harrison, N. J.

Chicago • Boston • Cedartown, Ga. • Richmond, Calif.

JOURNAL

Official Publication of The Society of Plastics Engineers, Inc. 409 Security Bank Building, Athens, Ohio.

POSTMASTER. Forwarding and Return Postage Guaranteed.

UNIVERSITY OF MICHIGAN
GENERAL LIBRARY
ANN ARBOR MICHIGAN

Molding

(Continued from Page 23)

one of the chief factors to be considered when developing exactly how a component may be cored.

The use of cores may often provide one of the most simple and economical means for ensuring the uniformity of wall thickness throughout a component, which again is another very essential requirement with both compression and injection molding, for the reasons to be explained shortly.

The mold user will also gain much assistance from a well-cored mold. Better moldings may be produced with a minimum of trouble. Improved control over curing will be ensured. The length of cure can often be reduced by reason of the thinner wall sections employed. Sticking to cavity walls may be avoided if the component has a substantial core plug on which it may contract before the mold is opened.

The importance of correct coring will thus be appreciated from the above points, and it will be seen how essential it is for the component designer to give the most careful thought to this aspect of a design form to be selected.

Wherever practicable the designer should select those hole locations which permit core plugs being mounted in the mold at *right angles* to the parting-line surfaces. Holes, etc., situated at awkward or difficult inclinations to the parting of the mold may entail very great difficulties for the mold designer and user.

Holes should be continued clean through the component if possible to avoid having to use core plugs unsupported at the end projecting within the cavity area. In the case of a compression molding having to be produced with a number of blind holes of small diameter but considerable depth, troubles may be experienced in the following manner.

The walls of the mold cavity and, of course, any projecting portions situated therein will be subjected to considerable thrust from the flowing plastics material in the mold. Unsupported and slender core plugs may thus easily be distorted, deflected or fractured as a result of being subjected to such pressure.

In addition, with most thermo-setting materials, a considerable abrasive action arises between the mold surfaces and the material during this flow stage. To make allowance for this abrasive action and resultant wear the mold designer will desire to make the core plugs to the *largest possible size* permitted by the tolerances allowed on the holes.

The core plug in course of time will wear smaller, and will have to be discarded when its diameter has worn down to the bottom dimensional limit allowed on the hole size.

To permit a reasonable length of working life to a core plug, it should preferably be amply supported at each side of the cavity formation. This means that holes should be formed clean through the wall of the component if practicable. It also means that the tolerance of the range of variation in size should be as large as possible.

Holes and openings, should not have undercut portions which necessitate a large size on the core at any point below the parting line of the mold. In other words, their shape should be of such a character as will ensure the largest diameter of the core being located on the parting plane of the mold blocks. If this is not accomplished it may be found that innumerable complications arise in connection with the mold construction and operation. Thus, in the case of a compression mold, it may necessitate the use of side splits, and loose bars in order to core in the required undercut portions. Introduction of such units will nearly always add to the handling time of the mold, and in many instances may also result in the formation of additional flash lines on the exterior of the component by reason of the extra intersection or joining lines contained in the mold.

If undercut portions have to be formed in the walls of an injection molding it may require using collapsible core plugs or other similar devices to allow the component to be readily removed when the mold is opened. This point will be more fully dealt with at a later point in connection with certain mold designs and constructions which it is intended to describe and illustrate.

(To be Continued)

This article is reprinted by permission of the English magazine "Plastics".

Burkhart and Wuest Promoted At Lincoln

Lincoln Plastics Corporation, of Cambridge, Ohio, has announced the appointment of M. W. Burkhart as general manager and L. M. Wuest as chief engineer.

Prior to accepting this position with Lincoln Plastics, Mr. Burkhart had been asociated in a variety of engineering and management capacities with Cambridge Molded Plastics Company, Plastics Division of Continental Can Company, Reynolds Spring Company, Newark Plastics, Inc. and General Motors Corporation.

He also had been associated with Plastics Design & Sales Company, where he was engaged in consulting, product design and tool engineering. In this position he did some of the earliest work on large injection moldings. Mr. Burkhardt is a member of the Society of Plastics Industry and the Society of Plastics Engineers. He served as president of the Central Ohio Society of Plastics Engineers in 1949 and 1950.

Before joining Lincoln Plastics as chief engineer, Mr. Wuest had spent six years as chief engineer of Standard Products Company, Plastics Division. With 13 years of service in the plastics industry, Mr. Wuest's experience includes engineering, cost estimating, tool design and product design. He specialized in work on large refrigeration moldings. He is a member of the Society of Plastics Engineers.

TRU-CAST
Beryllium Copper Castings—are Precision Engineered to Exacting Demands by Master Craftsmen!!

DEMAND THE BEST
INSIST ON TRU-CASTINGS!

MANCO PRODUCTS, Incorporated
2401 SCHAEFER ROAD
MELVINDALE, MICHIGAN